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NEW ENGLISH FREIGHT RATES, as submitted by the Board of Trade for the consideration of the railways, after five months consideration, but deemed likely to be vigorously opposed by them as too low, and pronounced by *Engineering* to be "a great improvement on the proposals submitted by the railway companies," are shown in the following table. The new feature of a separate charge for terminal service and transportation is included. *Engineering* justly remarks that the terminal charges alone are higher than our total charges for transportation "for short distances in some of the higher classes," the quoted limiting clause being rather gently put in view of the fact that our average rate per ton per mile on all freight was only 0.976 cts. in 1889:

PROPOSED ENGLISH FREIGHT RATES IN CENTS PER MILE.

CLASSES.	Under 20 miles.	Between 20 and 50 miles.	Between 50 and 100 miles.	Over 100 miles.	Station charge with terminal.	
A over 250 tons	1.7	1.5	1.2	0.9	0	0
A under " "	1.8	1.6	1.3	1.0	0	0
B	2.5	2.3	2.0	1.7	18	36
C	3.4	3.2	2.9	2.3	(21)	(42)
1	4.4	4.1	3.6	3.1	(4)	(48)
2	5.3	5.0	4.4	4.0	(27)	(54)
3	6.0	5.7	5.4	4.7	(30)	(60)
4	7.2	6.9	6.6	5.8	(33)	(66)
5	8.4	8.1	7.5	6.8	36	72

Class A is minerals, and constituted in 1889 201.6 million tons out of a total of 281.8, leaving only 80.2 million tons of general traffic. English railway returns do not give ton mileage. Of the coal tonnage *Engineering* estimates that half is hauled less than 20 miles and half of the rest less than 30 miles; on what grounds is not stated, and that the present usual rate per ton-mile is 2 to 3 cts., much higher rates being also enforced. In the United States the total production of coal, iron ore and metals is some 400,000,000 tons, and the total tons carried on railways 619,137,237 tons. There is, however, a large stone traffic, aggregating perhaps another 100,000,000 tons.

THE BALTIMORE BELT RY. CONTRACT was let to Ryan & McDonald and McCabe Bros., of Baltimore, by THOS. M. KING, Vice-President of the Baltimore & Ohio R. R. Co., on Sept. 4. The total cost of the railway is estimated at $5,000,000, of which over half will be the cost of excavating the tunnels.

WORK ON THE DUNDERBERG MOUNTAIN RY. is being pushed as much as possible, and it is expected that the grading will be completed by Dec. 1. At present the 5 contractors who are building the line have about 1,500 men employed. All material used in the construction has to be carried up the mountain by pack-horses, 150 lbs. being the usual load for each horse. When completed the road will be 11 miles long.

A CHEAP METHOD OF FILLING WATER TANKS on railway lines (which is merely the revival of an old idea, however) has been patented by Messrs. LAYMAN and RICE. The invention consists of an arrangement of slides, ropes and pulleys, by means of which a locomotive raises to the tank as much water as is taken from it. In this way the expense of a pump and man to look after it is rendered unnecessary. The only tank filled by the Layman-Rice apparatus yet in use is on the Dardanelle & Russellville R. R., where it is said to give great satisfaction. A public trial of the apparatus was recently made in Memphis, Tenn., which is stated in a newspaper exchange to have been very successful. A similar plant has been in use for years in Canada, if our memory is not at fault.

VERY HIGH RAILWAY SPEEDS are recorded by a Mr. W. C. H. CHURCH in *Engineering* of Aug. 22. In running from Edinburgh to London by the West Coast route he gives time and mile-post for no less than six miles averaging 80 miles per hour, made on a 0.8 to 1.33 pe. cent. down grade. No less than 15 miles are tabulated at speeds ranging from 73.4 to 81.8 miles per hour, and 14 miles together averaged 78 miles per hour. The motion is alleged to have been so smooth that "there was nothing to tell the passengers whether they were going 80 miles an hour or 18." The engine had 17 × 24 in. cylinders and 6 ft. 3 in. drivers; the load was 10 coaches, or say 120 tons.

A NEW AIR-BRAKE was exhibited on the New Jersey & New York R. R. on Aug. 28, near Hillsdale, N. J., to a party of railway men. The brake is interchangeable with the Westinghouse, and is being pushed by the New York Air Brake Co. The exhibition train consisted of eight cars, six equipped with the New York Air Brake Co.'s brake and two with the Westinghouse brake. An emergency stop was made with the train running at 50 miles per hour. The train is said to have come to a standstill within a distance of about 700 ft. The next test was a break-in-two with the train running 30 miles per hour, and the three cars in the rear were stopped in a distance of about 175 ft.

BETTER BRAKES FOR ELECTRIC CARS are needed, the increase in size and carrying capacity of the cars making the present brakes, worked by hand, too weak for an emergency stop. It is stated that the West End Railway Co., of Boston, will try vacuum brakes, worked by an air pump, run by an eccentric on the car axle.

THE WORST ACCIDENT of the week was a derailment on the Northern Pacific, on Sept. 1, near Hot Springs, Wash., at a point about 60 miles east of Tacoma. The train consisted of nine cars with two engines at the head, and the six forward cars left the track at a broken rail. The smoking car was badly wrecked by collision with a tree, which was forced into the middle of the car. Two persons were killed and 16 injured.——The boiler of a New York, Pennsylvania & Ohio freight locomotive exploded at Pavonia, O., killing the engineer and fireman. ——A similar accident to the one on the Reading Gravity R. R., reported last week, has occurred in the Austrian Tyrol. A car became uncoupled from the train at the top of a steep grade and ran down the line so fast that it left the track at a curve and fell over a precipice. Five passengers were killed and many injured. Evidently Continental engineers have something to learn concerning the use of automatic brakes.

AN INSTRUCTIVE ACCIDENT occurred on the New York, New Haven & Hartford at the Mianus River drawbridge this week. The engineer of a passenger train passed the distant signal, which was set at danger, and did not come to a full stop, intending to stop before he reached the home signal. For some reason he was unable to do so, and the engine and first car went off the track at the derailing switches. A few occurrences like this are worth all they cost in teaching engine-drivers to obey signals.

A BRIDGE FELL under an Iowa Central freight train on Aug. 27. It was an old wooden bridge over a small stream near Peoria, Ill.——A highway bridge at Defiance, O., fell, Aug. 28, under two heavy loads of lumber, precipitating two men and four horses into a ravine 40 ft. below. The bridge had been built only a few months. The *Defiance Republican* sagely remarks that it seems like an intervention of Providence that the bridge did not fall when some heavily laden omnibus was crossing. To which it might well add that it certainly was not the fault of those charged with the erection of the flimsy structure that it did not do it.

TWO ELECTRIC CAR ACCIDENTS are reported, one at Joliet, Ill., where a car became uncoupled from the motor and ran down a grade, leaving the track at a sharp curve and turning over into the gutter. ——A car on the West End Railway in Boston collided with a steam road roller. The car and its occupants got the worst of it, and five of the latter were badly hurt.

THE WARSHIPS OF THE WORLD are tabulated for 1889 in Lloyd's Register of shipping, as follows:

	Britain.	United States.	France.	Germany.	Italy.	Russia.
Number of first-class armor-clads (18-in. armor and above)	19	..	13	..	10	7
Other sea-going armor clads	41	..	27	16	11	17
Cruisers and sloops (above 900 tons)	165	47	63	35	22	32
Gun vessels (over 600 tons)	47	3	11	4	17	4
Gunboats (over 200 tons)	81	2	37	10	22	14
War vessels over 14 knots	169	19	75	44	55	28
Merchant ships to each cruiser or sloop	39	9	8	21	10	7
Merchant tonnage to each cruiser or sloop	49,000	11,000	13,000	26,500	13,600	5,000
Merchant ships to each war vessel	38	22	7	17	4	8

By another table, Great Britain has 50 ships of over 20 knots speed, against only 5 French and 2 German; and 83 in all of over 18 knots, against 26 French and 19 German. These recorded speeds, however, are in every case "measured mile" speeds, we believe; a quite different matter from the average of a 4-hour run.

THE ERICSSON SUBMARINE GUN is to be exhaustively tested, Congress having appropriated $30,000 for that purpose. The gun on the *Destroyer* is 36 ft. long and 16 ins. diameter, firing a projectile weighing 1,450 lbs. and 25 ft. long, charged with 300 lbs. of high explosive, with 12 lbs. of slow-burning prismatic powder, the initial velocity being such that 300 ft. through the water is traveled in less than three seconds. So much Capt. ERICSSON determined before his death, but the projectile has never yet been fired charged with explosives. The *Destroyer* is 130 ft. long, only 12 ft. beam and 11 ft. deep; designed to fight bow on at a distance of about 300 ft. and protected only by a slanting transverse armor plate at an angle of 45° with the horizontal.

THE NIAGARA TUNNEL CONTRACT is said to have been awarded to Rogers & Clement, of New York City, who has given $300,000 bonds for the faithful prosecution and completion of the work.

THE CHESAPEAKE & OHIO CANAL has been ordered sold, the receivers finally reporting that it could not be made to pay if it were repaired and put in running order.

SOME ENORMOUS CAST-IRON WATER MAINS are being turned out by the Addyston Pipe & Steel Co., at their Newport, Ky., works opposite Cincinnati. The pipe is 60 ins. in diameter and is cast in 12 ft. 4 in. lengths, each of which weighs 6 tons. The shell of the pipe is a little over 1 in. thick. The pipe is to be used for the supply main to the pumping station at Milwaukee, Wis. About 4,800 tons, or 9,600 ft. are to be furnished.

THE ALLOWANCE FOR SURVEYS of public lands will be about $425,000. Of this amount Washington receives $100,000, Montana will have $70,000, each of the Dakotas $40,000, and Idaho and Wyoming $20,000 each. An additional sum of $100,000 will also be spent in South Dakota in surveying the Sioux Reservation.

Car Heating Systems and Appliances.

We have before alluded to the rapid progress made by the Consolidated Car Heating Co. in the perfection of appliances for heating cars by steam from the locomotive. The company enters the field for the season of 1890-91 offering some new appliances and systems which are of especial mechanical interest.

The company justly states, in a catalogue about to be issued, that the practicability of car heating by steam from the locomotive is now certain. That steam heating is practicable is demonstrated by three years' experience, and it should be noted here that the company claims that 8,000 cars are equipped with its devices in whole or in part, and that over 22,000 of the various forms of steam couplers which it controls have been sold to railways.

The safety of steam is shown by the fact that it has been extensively employed for three years without a single accident. On the other hand, the record of even the mild season of 1889-90 shows that the danger from the "deadly car stove" is by no means imaginary. The following list of accidents to cars

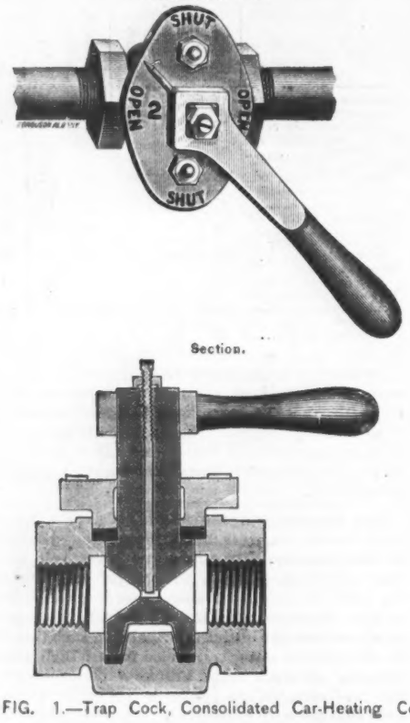


FIG. 1.—Trap Cock, Consolidated Car-Heating Co.

heated by steam and by stoves during the past winter has been compiled by the company:

At White Sulphur Springs, W. Va., Dec. 28, 1889, 10 persons were killed and others pinned in the wreck. Steam heat prevented a disastrous fire. At Thompson's Falls Mont., Jan. 3, an emigrant train went down an embankment, and the baggage car caught fire. At Sydney, Neb., Jan. 9, two sleepers, a car containing valuable registered mail, a baggage and an express car, were burned. At St. Hilaire, Can., Jan. 13, several passenger cars overturned by the wind caught fire. At Glendale, near Cincinnati, Jan. 17, five persons were killed in a collision, or subsequently burned to death, two coaches having been consumed. At Monument, near Colorado Springs, Jan. 25, two coaches and a sleeper were blown from the track and took fire, and 20 persons narrowly escaped death. At Butler, Mo., Jan. 26, an engine and a mail car went over an embankment. At Binghamton, N. Y., Jan. 29, a rear sleeper was partially wrecked, but steam was used, and fire did not follow.

At Ohio Pyle on Feb. 8 a postal and a baggage car went into the river, and the baggage-master was burned by the car stove. At Huddleston's Mills on Feb. 9 a mail car was demolished and an express car took fire. Near Hamburg, N. Y., March 6, a coach and a sleeper were destroyed and six persons killed, but steam was the heating agent and fire did not ensue. At Delta, Cal., April 2, a coach was wrecked and a conductor pinned in and burned to death.

The chief requirements of a good car heating system are enumerated as follows:

1. Evenly-regulated temperature, as related to health and comfort of passengers. 2. Consumption of locomotive power. 3. Simplicity of operation, and 4. Simplicity of construction; first cost and repairs.

The company rightly places the regulation of the temperature first, as the most important matter to be looked after in the application of continuous steam heating. It has been the general report that where direct steam is used the difficulty of regulating the heat to correspond to the outside temperature has been the greatest fault of the new method of heating. Concerning this matter the company claims that its systems do not overheat the cars. All the Consolidated Company's systems use hot water, either wholly or partially, as a medium of storing and radiating heat. The company has also just put on the market an automatic temperature regulator, and contracts, as a condition of the sale of this device, that the temperature of any car to which it is attached will be kept by it in all cold weather, when steam is applied between 68° and 72°.

This regulator is of a new design. It is not an electrical device, and is not in any way connected with the air brake apparatus. On what principle the device works is not stated, but it is probably a "differential bar," depending for its action on the different rates of expansion of two pieces of different metals, joined together at the ends. The price of the regulator is $50, or $35 if used in connection with the Consolidated Company's heating systems.

Another new device recently placed on the market is the trap cock shown in the accompanying engraving, Fig. 1. The company has wholly discarded thermostatic traps, on account of their great liability to become clogged, and has adopted instead the trap-cocks shown herewith in its place. The device is described as follows:

The trap cock is a plug cock of special pattern, with an opening through the plug of hour glass form. The final aperture in the center of the plug is 7-64 in. in diameter. The plug is, however, so constructed that this aperture can be reduced by turning a screw, the head of which shows in the center of the trap cock handle. A lock nut holds this screw in adjustment.

Careful experiment has demonstrated that an aperture 7-64 in. in diameter will, under usual steam pressure, just carry off the water condensed from the steam which is required to keep the largest car in a comfortable condition in cold weather. If the weather is extremely cold and more steam is admitted, the additional pressure will force the extra condensation through the opening in the trap cock. If the weather is mild and but little steam is used, there is slight pressure and but little water will pass through the opening. When the trap cock is once adjusted upon a car, it requires no after attention.

Small particles of scale easily pass through the cock. Should it ever become stopped by any large particle of dirt or scale, the handle can be reversed from "open" to "open," when the pockets shown in plug are also reversed in position and any obstruction is at once washed out. In this way obstructions the size of a small marble or a 10-cent piece, will readily pass through the trap cock and to the ground. Such an obstruction, or even small pieces of scale, will interfere with and often entirely prevent the working of the usual thermostatic trap.

The trap cock has always an opening equal in area to the opening in an ordinary thermostatic trap. It is evident, however, that the equal area opening in the trap cock, being in the form of a circle, will allow particles of dirt of larger diameter to pass than possibly could do so through the long and extremely narrow opening of a thermostatic trap. The trap cock can be wholly closed when in stations, so that no water falls to the ground.

This device is placed inside the car where it cannot freeze. Its price is $10. For direct steam systems a trap valve, acting on the same principle as the device above described, is substituted for the thermostatic trap.

The different systems of car heating which are applied by the Consolidated Car Heating Co. to meet the varying demands of different railways and different climates, include direct steam systems, hot water systems, and combined steam and hot water systems. The Commingler storage system which is illustrated herewith has been but recently perfected, and is placed on the market for the first time for the season of 1890-91. It is, in our opinion, a system of great promise, combining the advantages and eliminating the disadvantages of direct and indirect heating to a remarkable degree.

In deciding upon the best system for steam car heating, railway managers have had to choose between two systems, the direct steam and the hot water system, each of which has special advantages. The direct steam system is somewhat the cheaper and simpler. The car is warmed by it more quickly and can be kept warmer in very cold weather, with a given radiating surface. On the other hand the hot water circulating system gives a less intense and therefore more agreeable heat. It can be regulated with the greatest precision, so that the car will not be overheated in moderate weather. The stored heat in the circulating pipes will keep the car comfortably warm for three or four hours after steam is shut off.

It is thus evident that each of these systems possesses advantages over the other; and it follows, therefore, that a system which is either a direct steam or hot water system as desired, and combines the advantages of each is superior to either. The Commingler storage system is a direct steam system or a storage system or a hot water circulating system as desired, and is changed from one to the other by simply turning a valve.

The radiating pipes in the car are arranged in the ordinary manner, and when the car is already piped for direct steam this system may be applied without disturbing the radiating pipes. The basis of the system is the McElroy "commingler," a section of which is shown herewith in Fig. 2. It is simply a

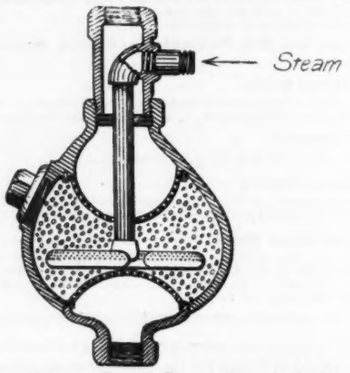


FIG. 2.—The McElroy "Commingler."

device for heating water by steam without the noise and pounding of the pipes, due to the intermittent condensation of the steam. As seen by the engraving, the commingler is merely a small chamber filled with pebbles, into which steam passes from a perforated distributing pipe and is condensed by contact with the pebbles and the water in the interstices between them. The water is thus quietly and effectively heated by the steam and circulates continuously through the radiating pipes.

The arrangement of pipes for the commingler storage system is shown on the accompanying engravings, Figs. 3 and 4:

A small commingler specially designed for this system, is placed under opposite middle seats at the side of a car and between the floor of the car and the sheathing, thus utilizing space not otherwise occupied. Into this commingler, 3 *A*, steam enters from the train-pipe, through the regulating valve, 3 *B*, at very low pressure—about two pounds—and thence makes its way into the heating pipes of the car, following the course shown by the arrows in the cut. As heat is given out, the steam condenses and the water of condensation returns to the lowest part of the system—the commingler, 3 *A*—where additional steam is continually and noiselessly injected into the water. In this accumulating water heat is stored and mildly radiated therefrom, until finally the whole piping becomes filled and a circulation of hot water is created by the steam.

When the piping is full the surplus condensation overflows through overflow fitting, 3 *K*, and thence through the trap cock, 29, down the pipe connected therewith to the drip, where it falls to the ground. The drip cannot freeze, as it is in metallic contact with the base of the commingler 3 *A*, which base is directly connected with the train-pipe, and so is always filled with steam. This feature of drip protection is used generally upon the systems of the Consolidated car-heating company.

By opening the drain valve 3 *H*, controlled by the wheel 3 *F*, the water of condensation is drained from the system and the apparatus then becomes a simple direct steam system. Whe steam is first turned on, the car is quickly heated by direct steam; wheel 3 *F* is then turned, the drain valve 3 *H* is so closed, and the direct steam system gradually and automatically converts itself into a hot-water circulating system

Whenever, at stations or elsewhere, it is desired to avoid any drip, the trap cock, 29, is shut, and not a drop of water can escape. When the car is laid off for the night, or for more than three or four hours (for three or four hours it will keep warm from stored heat), the drain valve, 3 *H*, and the regulating valve, 3 *B*, are opened, and the entire system is quickly emptied of water, air entering up through the drip pipe and overflow fitting, 3 *K*. The car is then ready to stand out indefinitely in any temperature whatever, without danger of any part of the apparatus freezing, and is also in readiness to be quickly heated by direct steam when again brought into use. Like apparatus is placed on each side of the car, thus allowing each side to be heated separately. Where the automatic temperature regulator is applied it controls the admission of steam to both sides of the car.

The application of this apparatus to a car already piped for direct steam is exceedingly simple. All the working parts are shipped in one piece, as shown in the above engraving, and it is only necessary to cut holes in the floor and sheathing, drop in the floor plate, to which the commingler and other parts are attached, and make connection with the train pipe and radiating pipes. The cost of the system is given about as follows for equipping a car complete:

Heating pipes, train pipes, etc. (For a 50-ft. car, bill of material will be about as follows: 225 ft. of 2-in. and 320 ft. of 1¼-in. black iron pipe with extra heavy special fittings for heating pipes in car; 56 ft. 1¼-in. black iron pipe with extra heavy special fittings for train pipe; 60 ft. asbestos and felt sectional covering for train pipe; two special asbestos-packed, 1¼-in. cocks for train pipe, with floor plates, spindles and large T-wrench, *or* one three-way 1¼-in. cock for train pipe with floor plate and wrench.)	$85
Special material for commingler storage system. (Consisting of two small commingiers, with valves, floor plates, trap cocks, etc., as shown in cut.)	60
Two couplers, with hose complete, McElroy, Sewall, Peerless or Westinghouse	15
Pipe shields, additional	10
Applying special material to car ($15 to $25)	20
Total cost of equipping car	$190

In an open letter to the stockholders of the Standard Car Heating & Ventilating Co., which joined the Consolidated Co. last spring, Mr. GEO. WESTINGHOUSE, JR., expressed the following opinion:

The Commingler system, it seems to me, most nearly solves the problem of car heating. This system involves the use, within the car, of pipes containing water, with which steam is noiselessly commingled through an ingenious device which has the effect of quickly heating and circulating the water, and admits of the utilization of a great part of the latent (stored) heat, which is necessarily wasted in all direct steam systems, and secures the regulation of the temperature of the water from 70° up to whatever is required for the coldest weather; thus making it possible to avoid the annoyance and discomfort which result from the use of those systems whereby the steam is admitted directly into the pipes at not less than 212°.

The above system, however, is only one of the new improvements which the Consolidated Car Heating Co. is perfecting for railway use. Among couplers and permitting the use of either ball and swivel or hose connections; fireproof heaters for any water circulating system; a safety valve and expansion drum for water heaters; special extra strong pipe fittings for car-heating work, ingeniously patterned so that right and left threads may be distinguished at a glance; glass models of the company's systems for the instruction of trainmen; a return system of steam heating, especially adapted for elevated railways since there is no drip; a storage system of street car heating; and last and most important, provided it proves a commercial success, a system of train electric lighting by which each car will be lighted independentiy with slight tax on the power of the locomotive.

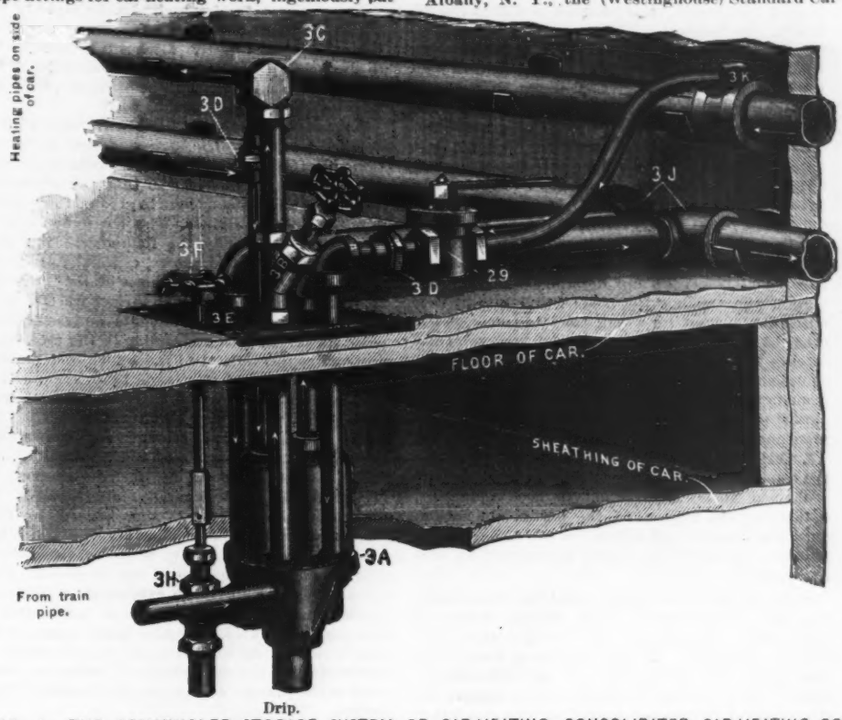


FIG. 3.—THE COMMINGLER STORAGE SYSTEM OF CAR-HEATING, CONSOLIDATED CAR-HEATING CO.

As regards the economy or extravagance of steam heating, concerning which the most extravagant statements have been made, the Consolidated company makes the moderate statement that the economy by a well devised system of steam heating will be from $15 to $40 per car per year, depending upon the cost to the railroad of stove fuel and of locomotive fuel, upon the climatic conditions, and upon the system of steam heating adopted. The company offers to submit to any railway on application an estimate of the saving which can probably be effected by the use of steam heating.

The Consolidated Car Heating Co. now represents the largest aggregation of capital and controls the greatest number of patents (about 100) of all firms engaged in car heating work. It has been formed by the union of the Sewall Safty Car Heating Co. of Portland, Me., the McElroy Car Heating Co., o Albany, N. Y., the (Westinghouse) Standard Car Heating & Ventilating Co., of Pittsburg, the (Murdock-Peerless) Automatac Car Heating Co. of Detroit, and the (Leland) Universal Car Heating Co., of New York. The officers of the Consolidated Co. are: ROBERT C. PRUYN, President; D. D. SEWALL, General Manager; JAS. F. MCELROY, Mechanical Supt. Its general offices are at Albany, N. Y.

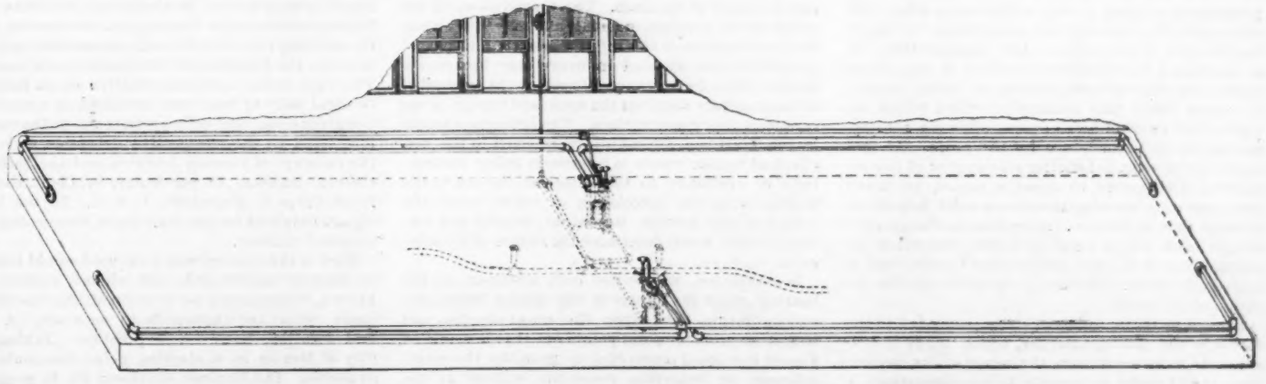


FIG. 4.—THE COMMINGLER STORAGE SYSTEM OF CAR-HEATING, WITH TEMPERATURE REGULATOR.

the new devices now ready or in preparation, are a disk drum system of steam heating, applicable to any water heater, and of great capacity; a "Consolidated" steam coupler, which is heralded as the coming universal coupler, combining features of the Sewall, McElroy, and Westinghouse steam

The Relation of Irrigation Problems to Forest Conditions.

In 1889 a report on this subject was presented to the Senate Committee on Irrigation by Mr. B. E. FERNOW, Chief of the Forestry Division of the Department of Agriculture, and from this report we make some extracts likely to be of interest from an engineering point of view in regard to irrigation:

The main question is by what means can the precipitation falling over the area comprised in the arid region be made to do the most duty, and the special point discussed is whether, in what manner and to what extent a forest cover may be expected to assist in the thorough utilization of the precipitation and atmospheric humidity for agricultural purposes?

Considering the relation of forest conditions and irrigation problems with reference to the special case of the arid regions of the West, the writer after much study, and a hurried and partial inspection of the ground, feels justified in stating the following conclusions:

1. Reforestation on the plains and preservation on the mountains are of greater national concern than the location of irrigation reservoirs.

2. While the location, construction and systematic regulation of such reservoirs under government control is, under given conditions, feasible and desirable, their purpose will be better subserved if, at the same time, attention be given to forestry in connection with the irrigation systems.

3. While forest preservation and extensive reforestation are not only coadjutors of irrigation systems, but supply in part the conditions which irrigation and reservoirs are designed to accomplish, neither the one nor the other will invite private enterprise at least for a long time to come; on the other hand, the location of irrigation reservoirs and ditches has been and will be, as need arises, accomplished by private enterprise. This statement is made without disparaging any attempts on the part of the government to assist such private enterprise and to give it systematic direction.

4. Certain difficulties and dangers which attend the construction of reservoirs will be increased by continued forest destruction in the mountains, induced by the neglect on the part of the nation, and these dangers and difficulties will be avoided or reduced by a national forest administration and reforestation.

Such conclusions are based mainly on the assumption that a forest cover exerts certain influences which affect conditions of water supply and other climatic conditions. When considering these influences, especially with reference to agricultural pursuits, it is a mistake to discuss them seperately, since vegetation does not depend on any one factor of climate, but it is rather the balancing of several factors which produce favorable conditions of growth. Vegetation does not, as it is so often stated, depend on rain-fall—certainly not on the mean annual rain-fall—but on conditions of atmospheric as well as soil humidity, and conditions of transpiration or evaporation respectively. Therefore agriculturists in regions with plenty of rain-fall yet find it advantageous to have recourse to irrigation, in order to supply the exhaustion by rapid evaporation and transpiration. One of the most important studies in connection with irrigation problems will be that of the rate of evaporation and of the influences promoting or retarding it. In this direction hardly any data are as yet collected, and we can hardly anticipate how much a single "chinook" of 24 hours' duration may waste the water of a reservoir or dissipate the snow which lacks the protective forest-cover.

The simple mechanical impediment which a timber belt or even a single row of trees opposes to the progress of a drying wind is sufficient to affect the crop under the shelter of the wind-break by lowering the rate of evaporation and transpiration. If, as is claimed, there has been observed in the Plains region any effect of tree-planting on water supply, it is most likely this mechanical effect which the timber belt or wind-break exerts, allowing a better utilization of the moisture by the crops. At first sight this mechanical shelter may appear of too restricted a character to deserve notice, yet many facts concur in showing that it is a most important element in local climate. According to Becquerel a simple hedge 6 ft. in height will give protection for a distance of 70 ft.; and according to Hardy a belt of trees every 300 ft. will defend vegetation against the action of the wind.

Thus, if no other influence were conceded to the forest in the plains, this one, which tends to conserve the moisture within the range of its protection, would make systematic forest plantations a most desirable adjunct to irrigation systems. Summer and winter drought, i. e. rapid evaporation, is the bane of the farmer in the plains, and is due to the continuous dry winds, which can be checked by rationally disposed timber belts. Another mechanical influence is that which the forest cover on the mountain sides exerts in retarding the melting of the snow and the drainage of water, thus prolonging the period during which the same may be made available. Complaints that the snows do not lie as long into the summer as they used to before the forest cover was removed, may be heard all along the eastern Colorado slope, where irrigation has been practised in the most rational manner and the waterflow best observed. By the rapidity with which the water now flows off the bared mountains the effectiveness of the ditches is reduced by four to six weeks, there being an accumulation of flow at a time when it cannot all be utilized and a dearth later on when it could well be used.

Some one evidently but little conversant with the economies of nature has suggested that, in connection with the reservoir system, it would be desirable to remove the forest cover so that the snows may drift into the canyons, there to give up their waters to reservoirs and ditches. The consequence of deforestation are briefly the following: 1st. More rapid melting of the snows, especially under the marvelously exhausting influence of the "chinook." 2d. The more rapid flow of surface waters, which carry with them the thin mould and earth, gradually baring the rock and ending in the creation of destructive torrents. In France such torrents have carried debris over fertile lands 150 to 200 miles into the plain, to correct which an expenditure of more than $50,000,000 has been necessary. The forest offers natural storage for snows and rains, giving their waters gradually and for a longer period; by its destruction we invite floods and droughts alternately. The dams must be built with due regard to flood waters, and a study of the cloudbursts in the irrigation area is therefore highly desirable, especially as they are not as yet matters of regular record. That cloudbursts, like all violent exhibitions of meteorological phenomena, seem to occur more often in large unwooded area, may also point again to the employment of reforestation, as a preliminary or concomitant of the construction of irrigation reservoirs in the prairies and plains, as a measure of protection.

Another important influence of the forest in connection with irrigation problems is its tendency to raise the water level in its immediate neighborhood, a well established fact.

Forest influences are claimed to exist in the following directions:

1. On sanitary conditions.
2. On local climate.
(a) On temperature conditions.
(b) On humidity of atmosphere.
(c) On distribution of rainfall in time, and locally, perhaps, on quantity.
3. On soil-conditions, on water level, and on waterflow.

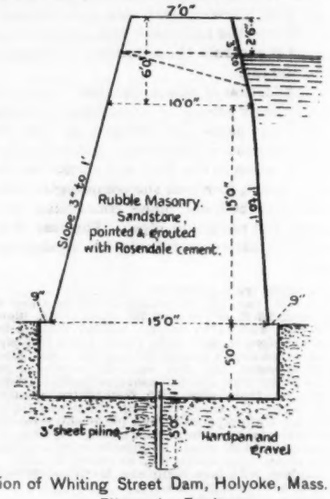
The writer calls special attention to the fact, which has too often been lost sight of when discussing the influence of the forest on climatic conditions, that the condition of the forest itself plays a very important part in determining its influence. Such conditions are given in the extent, the density, the position, the composition of the forest and the age or height of the trees. These conditions of the forest are of greatest moment and may alter absolutely the nature of the influence, so that the exact opposite of the expected influence may become apparent; when, for instance, a forest on the leeward of a water surface deprives the open land beyond of the benefit of this water surface. The influence exerted by the forest can, almost all, be referred to the mechanical barrier which it interposes either horizontally or vertically to the action of the sun or the winds, or to the percolation of water; hence the nature of this barrier, its extent, density and continuity must needs determine the nature of its influence.

In conclusion, the writer calls attention to the bearing which the forests of the Rocky Mountains and California have upon the water supplies and irrigation problems, and points out that it would be a most irrational proceeding to promote the establishment of irrigation reservoirs without at the same time arresting the irrational forest destruction which is invited by the neglect of government to administer its property rationally.

The Whiting Street Dam at Holyoke, Mass.

The accompanying section shows the main characteristics of the new dam for the Holyoke waterworks. The length of the dam on the coping is 1,773 ft., and its greatest height above the natural surface is 21 ft. It will form a reservoir, with a surface area, when full, of 112 acres and an estimated capacity of 600,000,000 galls. The material is hard, close-grained sandstone, pointed and grouted with Rosendale cement. The earth under the dam for 1,000 ft. of its length is a very compact and unyielding gravelly hard-pan. For the remaining distance the dam rests on a rock foundation, and here benches were cut, deepest on the water side, to connect the structure more securely with the foundation.

Beneath that part of the dam founded upon hard-pan, 3 in. sheet-piling, matched, was set in a trench 5 ft. deep and filled about with good puddle. The



Section of Whiting Street Dam, Holyoke, Mass. E. A. Ellsworth, Engineer.

piling extends 1 ft. up into the masonry of the dam and is made water tight there by the grouting of the masonry.

The spillway is constructed in the dam, 78 ft. from the south end, and is 16 ft. 8 ins. long by 2 ft. 6 ins deep at the outer or dry side of the dam, from which it slopes at the rate of 3 ins. to 1 ft. There are three discharge pipes, 12, 16 and 30 ins. in diameter, respectively.

The dam has cost $80,000, of which $60,000 was for the masonry. Delaney Bros., of Holyoke, were contractors for the masonry, and Mr. E. A. ELLSWORTH, also of Holyoke, to whom we are indebted for these data, was the engineer.

The Proposed Intercontinental Railway.

The idea of an intercontinental line of railway connecting the railway system of the United States with that of the republics of Central and South America is by no means a new one. Little, however, has been done toward carrying out such an enterprise until the present year, when the matter was taken in hand by the International American Conference assembled at Washington to consider plans for securing closer traffic and commercial relations between the republics of North and South America. The work of the conference relative to an intercontinental railway has been embodied in a report to Congress upon the railway systems of the nations interested by their respective delegates, and upon the railways of Spanish America, and the Intercontinental Railway in particular, by Lieut. GEO. A. ZINN, Corps of Engineers, U. S. A. To the latter we are indebted for the main facts concerning this proposed railway.

Much of the country which the road would traverse is entirely unsurveyed, and almost entirely unknown, consequently no location of the line can be made with any approach to accuracy. A general location, however, is possible. Taking the City of Mexico as a starting point, two routes are available. The Mexican Southern Ry. is projected south from Puebla, via Tehuacan and Oaxaca, to Tehuantepec, and thence along the Pacific coast to the Guatemalan frontier. Starting from the frontier, a route can be obtained along the coast to Guatemala City. From Guatemala City, a line proper, passing through Pasto and Ibarra to Quito. A railway has been projected to this point from Sibambe, 150 miles south, to which point the line from Guayaquil is now being constructed. From Sibambe the through line may go to Cuenca and Loja, thence

is now under survey to Escuintla. Thence the new line will follow along the coast through the State of Salvador to San Miguel, and from here a line may be secured directly west over an almost level country to the Goascoran River, crossing which it will continue to Chinandega, on the Nicaragua Ry., which can be used as a portion of the line by completing the break around Lake Nicaragua.

Leaving the Nicaragua Ry. at Granada, the intercontinental line would follow the shores of Lake Nicaragua to the boundary of Costa Rica and thence by either of two routes—the Atlantic or Pacific coasts being followed to the isthmus, or the Pacific coast to Esparta, thence across the State by the line now nearly completed to Matina, and from there south along the Atlantic coast to the southern boundary of the State.

The alternative route is from Minatitlan, the southern terminus of the proposed Alvarado Ry. extension, south, following the cart roads in the interior to San Cristobal, and thence southeast via Solola and Guatemala City to San Salvador, from which point the route previously described may be followed.

Resuming the line at the southern boundary of Costa Rica, it must traverse the Isthmus of Panama, about the topography of which very little is known, except a few miles on each side of routes surveyed for interoceanic canals. These surveys, however, indicate that the grades would not be serious. From experience in constructing the Panama Ry., however, it is probable that many other difficulties will have to be overcome. It cannot be told which coast it will be best to follow until surveys are made; but an interior route will be necessary in either case to escape the low marshy lands along the coast.

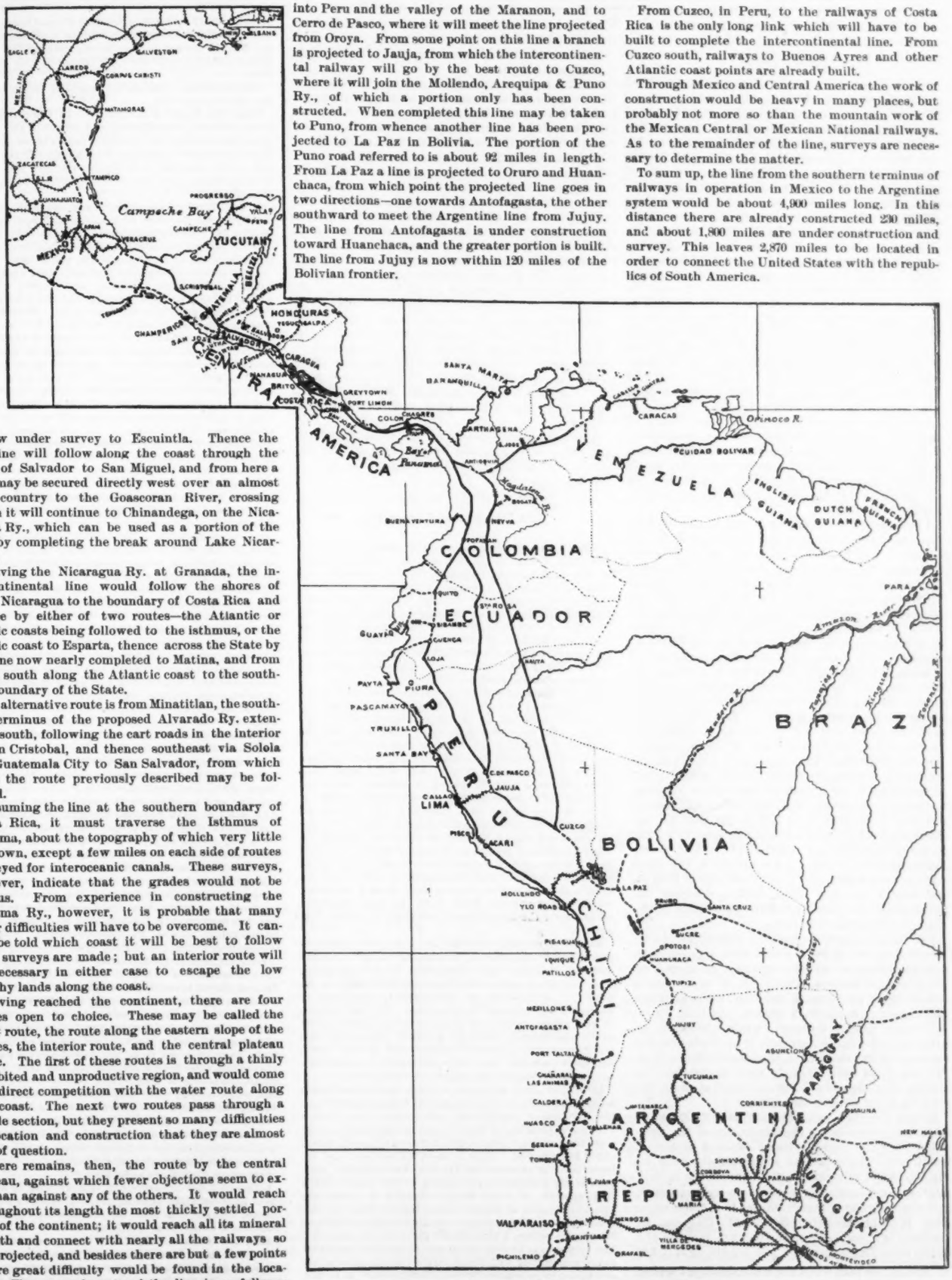
Having reached the continent, there are four routes open to choice. These may be called the coast route, the route along the eastern slope of the Andes, the interior route, and the central plateau route. The first of these routes is through a thinly inhabited and unproductive region, and would come into direct competition with the water route along the coast. The next two routes pass through a fertile section, but they present so many difficulties in location and construction that they are almost out of question.

There remains, then, the route by the central plateau, against which fewer objections seem to exist than against any of the others. It would reach throughout its length the most thickly settled portion of the continent; it would reach all its mineral wealth and connect with nearly all the railways so far projected, and besides there are but a few points where great difficulty would be found in the location. The general route of the line is as follows: Leaving Quibdo, in Colombia, the Cauca Valley would be entered at the first available opening in the Cordillera, and would be followed with an ascending grade to Buga, Cartago and Popayan, then, crossing the lateral ridge, enter the plateau into Peru and the valley of the Maranon, and to Cerro de Pasco, where it will meet the line projected from Oroya. From some point on this line a branch is projected to Jauja, from which the intercontinental railway will go by the best route to Cuzco, where it will join the Mollendo, Arequipa & Puno Ry., of which a portion only has been constructed. When completed this line may be taken to Puno, from whence another line has been projected to La Paz in Bolivia. The portion of the Puno road referred to is about 92 miles in length. From La Paz a line is projected to Oruro and Huanchaca, from which point the projected line goes in two directions—one towards Antofagasta, the other southward to meet the Argentine line from Jujuy. The line from Antofagasta is under construction toward Huanchaca, and the greater portion is built. The line from Jujuy is now within 120 miles of the Bolivian frontier.

From Cuzco, in Peru, to the railways of Costa Rica is the only long link which will have to be built to complete the intercontinental line. From Cuzco south, railways to Buenos Ayres and other Atlantic coast points are already built.

Through Mexico and Central America the work of construction would be heavy in many places, but probably not more so than the mountain work of the Mexican Central or Mexican National railways. As to the remainder of the line, surveys are necessary to determine the matter.

To sum up, the line from the southern terminus of railways in operation in Mexico to the Argentine system would be about 4,900 miles long. In this distance there are already constructed 230 miles, and about 1,800 miles are under construction and survey. This leaves 2,870 miles to be located in order to connect the United States with the republics of South America.



MAP SHOWING ROUTE OF PROPOSED INTERCONTINENTAL RAILWAY.

[Scale, about 1/50,000,000]

Cross-hatched lines show railways in operation; full lines, proposed intercontinental railways; broken lines, other proposed railways.

Diagrams of Hydraulic Formulas.

[WITH INSET.]

In the inset sheet which accompanies this issue we give a diagram which ought to be of occasional convenience, at least, to all engineers for approximately solving from a single sheet all the more important and elementary hydraulic formulas. We are indebted for the original of the diagram to Mr. J. LELAND FITZGERALD, M. Am. Soc. C. E., of Schenectady, N. Y., but we have modified the arrangement of details considerably, and we trust with advantage. All the curves are shown, however, precisely as drawn by Mr. FITZGERALD. He in turn was indebted to Messrs. RUDOLPH HERING and JOHN C. TRAUTWINE, JR., for the Kutter diagram in English measures, as given in their admirable work below referred to,* and they in turn to Messrs. GANGUILLET and KUTTER, the authors of the formula for the diagram in metric measures.

Although the diagrams are proposed only for "approximate" use, a very brief study of any one of them will show that the probable error of observation in using them, due to the fact that it is not feasible to either make or read such drawings microscopically, is far within the limit of error in the formula itself, so that no serious inaccuracy in practical work could result from using the diagram exclusively without recourse to the formulas themselves. All hydraulic formulas, especially, must, from the very nature of the fluid they deal with, be approximate only, liable to err considerably from a variety of causes.

For example, let us take the well-known Kutter formula, the most important one covered by this diagram, and beyond doubt the most accurate hydraulic formula having a wide range of application, which exists. The diagram is well worth reproducing for the insight which it gives into the properties of this formula alone. It will be seen that when the values of the "mean radius" R (and hence of $\sqrt{R}$) are small, the influence of the coefficient of roughness n is very great, and that it decreases as R becomes large, which is well; but it will also be seen that, let R become never so great, as for the channel of a great river, the influence of N still remains very great; and after R has reached the moderate value of 10 to 20 ft., no further increase of "mean radius," or in other words of average depth, seriously diminishes the effect of the roughness coefficient n, although beyond doubt the actual effect of variations in roughness of bed almost vanishes in very large streams. Gen. ELLIS long ago pointed out (Trans. Am. Soc. C. E., 1877, p. 250) that for the Mississippi River, with a true mean velocity of 5.93 ft. per second, taking $n = 0.03$ gives $v = 5.60$, a fair approximation, but taking $n = 0.01$ for a bed lined with cement would give a mean velocity of 11.35 ft. per second, or more than double, whereas the actual influence of such a bed on the velocity of the river would probably be small.

But while it must be admitted that a formula absolutely correct in form would give a rapidly decreasing effect to n as R became very great, and no effect when R became infinite, yet it by no means follows that "the formula, therefore, for large rivers and canals is apparently useless," as Gen. ELLIS somewhat hastily declared, while admitting its great value for smaller streams of all kinds. On the contrary, it has since been abundantly shown that, *for any of the cases likely to occur in practice*, including all extremes of large and small streams, the formula is one of singular accuracy.

A brief examination of the diagram discloses at once the overwhelming great influence of the coefficient n on the mean velocity obtained under all conditions. The slope has comparatively little influence on the value of c in the formula $v = c\sqrt{RS}$, to give which coefficient the diagram is constructed, and curiously enough this influence is at times negative. It will be seen that, in the side diagram, all the lines of n converge on the point in the axis of x of the main diagram where $\sqrt{R} = 1.811$, or $R = 3.28 = 1$ metre; so that when the mean depth is 1 metre, the slope has absolutely no effect on the coefficient. When it is less than 1 metre, increase of slope tends to *increase* the coefficient, and when it is over 1 metre, to *decrease* the coefficient. Of course, this cannot be quite correct. However it may be with the "British inch" and foot, the metre has had no such divine origin as to make the laws of nature vary with it, and Messrs. GANGUILLET and KUTTER recognized this fact by constructing a second general formula (little known and used), in which this contrast disappears.

But that the formula does give very accurate results under all conditions is proven by the results of the 1,200 gaugings recorded in the work just referred to,* covering a range from glass tubes with a "mean radius" of ⅛ in. to the Mississippi River with a mean radius of 20 to 50 ft. The dominating factor in determining the value of the co-efficient c being the roughness coefficient n assumed, this is given for each of the 1,200 gaugings recorded. Messrs. HERING and TRAUTWINE would have done well to give some digested summary of these gaugings, but as they don't it, must suffice to say that they run for pages together in substantial accordance with those given on the diagram published in this issue, the variations of any moment being few, although the observations are from widely different sources. It is therefore probable that for many years to come no attempt will be made to improve upon the Kutter formula, but that all efforts to obtain more precision will be directed to obtaining more exact values of n for all conditions for use in that formula. For most practical purposes Messrs. HERING and TRAUTWINE's lists give sufficient exactness already.

The remaining diagrams on the sheet we publish are sufficiently explained by the notes on the diagram itself, and hardly call for further comment or explanation.

* "A General Formula for the Uniform Flow of Water in Rivers and Other Channels." By E. GANGUILLET and W. R. KUTTER. Translated, with numerous additions, including the "Elements of over 1,200 Gaugings," by R. HERING and J. C. TRAUTWINE, Jr.

The Dangers of Electricity. †

When the development of electric currents, on a large scale and at a small cost, first became possible by reason of the discoveries of FARADAY, WILDE, GRAMME, SIEMENS and others, the questions of the dangers to life and property attending their use was brought prominently before the public, just as the dangers attending the use of steam, of rapid locomotion on railroads, and of dynamite were brought to the attention of the world when these powerful agencies first left the experimental laboratory of the chemist or engineer to take their part in the ordinary labor and business of life.

In each instance alike there was a class of people who took the narrow and partial view, that if an agency was dangerous it should be excluded altogether from public use, or, what amounted to the same thing, be surrounded with such exclusions and limitations as would rob it of nearly all its capacity for usefulness, and restrict all possibility of advance and development in its application. Thus laws were actually passed in England on the first introduction of steam limiting the pressure in boilers to 30 lbs. on the square inch. The first railroad charter contained a clause limiting the speed of trains to 12 miles an hour, and when a speed of 30 miles was suggested it was ridiculed in a prominent journal of the day as an idea simply insane, and it was said that people would just as soon be persuaded to allow themselves to be fired out of a cannon as to be hurled along at such fearful velocities, which would without doubt have the most disastrous effects upon the circulation of the blood and other vital actions.

Some of us can also recollect the excitement produced and echoed in the press on the introduction of dynamite, and the stringent laws regarding its transportation, which in many cases only increased the danger to the public by occasioning its surreptitious conveyance in passenger and ordinary baggage cars. We shall have to be very young, indeed, not to remember the great popular excitement brought about by the daily press when electric lighting first appeared in the streets of New York, and when flashes of flame were described as proceeding from a horse that had run against an electric wire.

In all the older instances matters have settled themselves in accordance with the laws of human progress and the diffusion of intelligence, and we now have boilers running at pressures of 140 lbs. and upward, trains going more than a mile a minute, and gunpowder largely superceded by dynamite. What is more, the accidents and injuries actually produced by these several agencies have been vastly less than those caused by the things which they replaced. A much smaller number of people are killed or injured by high-pressure boilers than by low-pressure ones. How rarely do we hear of the explosion of locomotive boilers, which usually carry 140 lbs. pressure? The accidents to express trains are as nothing compared to those occurring with freight trains, and the loss of life and injury to passengers by rail is insignificant in its percentage to the number carried when compared to similar loss and injury incurred in the days of stage coaches. The same relation has been found between dynamite and gunpowder, the former having largely reduced the proportion of accidents and injuries as compared with the work done.

Two lessons are very plainly taught by the facts of history above alluded to.

First. The world is not going to be frightened away from a new and valuable source of power by the circumstance inseparable from the very nature of all powerful agencies, that it is dangerous if not adequately controlled; but, on the contrary, will develop the new power to an ever increasing and therefore more (possibly) dangerous intensity.

Second. Intelligently managed and controlled, the most powerful, and therefore, in a sense, dangerous agencies become the most efficient protectors and servants of man, and not only aid him in his mission of subduing and utilizing nature, but actually protect him in his work.

Without these "dangerous" agencies man would be reduced to the lowest condition of savagery, where he would be at all times helplessly at the mercy of the "elements" or the blind forces of nature. With them he not only defies and subdues the beasts which would otherwise be his superiors, but even conquers and renders tributary to his comfort and advancement those vast forces which control the entire matter of the Universe.

Applying these lessons taught by the past history of the world in parallel cases to the problem of the distribution and use of electricity, we see in the first place that the way to deal with its dangers ought not to be the timid, obselete way of prohibition, or of unintelligent restriction, such as that which proposed the exclusion of locomotives from railroads, or the limiting of their speed to 12 miles an hour, but the sensible way of providing adequate safeguards to the new power, and with these allowing it to follow its natural line of development and growth into higher and higher ranges of intensity and consequent efficiency.

It is too well known to all to need statement that the methods thus pointed out by history and taught by experience have not been by any means universally advocated or followed, and that while many have loudly demanded the exclusion of powerful electric currents, or the limitation of their intensity to what they suppose to be necessarily harmless ranges, the users of such electric currents have in too many cases neglected the most obvious precautions.

It is only fair to say in explanation of this latter statement that this neglect has in many cases been brought about by obstructions thrown in the way of good work by those who were exciting themselves for the total abolition of dangerous currents, and who, like certain "total abstinence" advocates, objected to every mitigation of evil they attacked, because any such improvement weakened their case against it.

As regards dangers to property from fires, the matter fortunately fell at an early period into the hands of the Board of Fire Underwriters, who in a judicious and business-like way, investigated the subject and formulated such rules as have proved eminently satisfactory, and have proved that, under proper regulations as to good work and means of protection, electricity is by far the safest means known to us for the distributing and development of light, so far as "fire risks" are concerned.

In view of the satisfactory results thus obtained I regard it as a fortunate circumstance that the other part of the problem—namely, that relating to dangers to human life—has been recently taken in hand by a similar organization known as the "Employers' Liability Assurance Corporation." This association, after collecting a mass of material from a great variety of sources, some time since formulated a series of rules for the protection of those employed in erecting and operating electric apparatus involving the use of powerful, and therefore dangergerous, currents. These rules have been examined and approved by several of the managers of prominent electric companies, and so far it would appear as if no accidents have resulted from the use of electric currents where these rules have been followed, and that most, if not all, the accidents which have occurred would have been prevented had these rules been followed and obeyed. Having had something to do with the framing of these rules, it is my chief object in presenting the present paper to secure their criticism by those best able to perceive their imperfections and such suggestions as may lead to their beneficial modification or extension.

I therefore quote them as follows:

1. Do not touch or handle any electric wire or apparatus of any sort while standing on the ground, or while in contact with any iron work, gas or water pipe, or stone or brick work, unless your hands are covered with rubber gloves, and you are provided with such properly insulated tools as have been declared to be safe and in good order by the electrician or other competent officer of this company. If it is at any time necessary to stand on the ground, or on any surface not insulated from the ground, while handling electric wires or apparatus, rubber boots or an insulated stool should be used. In moving wires, hanging on or lying over electric light wires, lamps or fixtures, use a dry hand line.

2. Never handle any electric wire or apparatus with both hands at once when this can be avoided, and, if it is

† A paper by HENRY MORTON, President of Stevens' Institute, before the National Electric Light Association.

necessary to do so, be sure that no current is present, or that one or both hands are protected by rubber gloves or other efficient insulation.

3. When handling line wires treat each and every wire as if it carried a dangerous current, and under no circumstances allow yourself to make contact between two or more wires at the same time.

4. Never open a circuit which has been in use without giving notice to the superintendent, or whoever is in charge, of your intention to do so, and at the same time request that the same line be opened at the main station, and kept open until you have given notice that your work on that line is complete.

5. In the dynamo room never go near the belts or dynamos, nor touch any apparatus, unless you are fully informed and instructed how to do so.

6. Tools used by linemen should be provided with insulating handles of hard rubber or other equally good insulator. It is the duty of each lineman to look after his own tools and see that they are in good order, especially as to their insulation. "In construction work, a space of at least 20 ins. must be left between the holes for pins on the cross arms, so that a lineman may get to the top of the pole and work without danger.

7. Lamp trimmers and others engaged in the care of lamps must see that the switch putting the lamp in circuit is turned off before they handle the lamp in any way.

The same insurance association has collected the authentic records of a number of so-called "electric accidents" or accidents happening to the employés of electric companies. I have now before me the abstracts of 91 such cases.

The first thing that presents itself in looking over this set of abstracts is that very few of the accidents are in any way attributable to electricity directly, but would have occurred had the establishment in question been any kind of a factory where power was being used, or any place where heavy objects were being moved.

In fact, out of the 91 cases, but 15, or about 16½%, have any direct relation to electricity. As I have already mentioned, of the 15 cases in which the injury was in any way caused by electricity, there are none in which the accident would not have been avoided if the above quoted rules had been observed. Thus, beginning with first in order as arranged in the abstracts, all before it having no direct connection with electricity, we have:

"No. 11. While removing the wire from a Brush dial or regulator which had become short circuited, was slightly burned on two fingers of right hand."

In this case the beneficial effect of rule No. 2 was manifestly expressed, and had the spirit of rule 7 been complied with, even the slight injury experienced would have been avoided.

The next in order is:

"No. 20. Was putting carbon in electric lamp which was out of order and failed to burn. Received charge of electricity, which caused him to fall down from step ladder onto steam radiator. Two ribs broken."

This would clearly have been avoided by an observance of rule 7.

Time will not permit me to quote all the 15 cases, and I will, therefore, only repeat that they would, all of them, have been avoided by a strict observance in form and spirit of the above quoted seven rules or directions. Of course I do not mean to imply by this that these rules are perfect or complete, but only that they seem to be in the right direction, and to furnish a starting point from which further developments may proceed.

No one having an elementary knowledge of electricity as it existed 10 years ago needed or needs to be convinced of its power to do harm where all safeguards are removed, and the occasional declarations of its harmless character which have been uttered can only be accounted for by reference to that combative disposition which impels some minds always to take a view in opposition to any which may be expressed, and gives birth now and then to a book or pamphlet disproving the law of gravitation or the solar origin of light and heat. To say this is, however, far from agreeing with the other extremists who would banish electricity from our daily walks and occupations, or place it under restrictions which *might* render it harmless, but which *certainly would* render it relatively useless for the countless purposes in which its efficiency demands its full development. The true opinion is that which is supported by past experience, and which advocates the fullest developments of power to which this agency can attain, combined with the use of all the means of protection by which human intelligence can protect itself while using to the utmost this potent and, therefore, dangerous weapon in our victorious contest with the inimically destructive forces of nature.

DISCUSSION.

Mr. FREATHY, representing the Employers' Liability Assurance Corporation, described the early experiences of his company in its work. It was found that serious accidents were quite numerous, and the prejudice of the public was such that juries were sure to award heavy damages to injured employés under the belief that electric companies were carrying on their business in a reckless manner. It was necessary to advance the original schedule of rates 100% to cover these losses.

In order to reduce the accidents, all the policy holders in the United States were requested to send copies of their rules for employés to the company and these were submitted to President MORTON, who from them compiled the above standard rules.

On motion it was voted that the Committee on Data be requested to examine into and report all accidents occurring in electric light stations, with their cause.

The Efficiency of Storage Batteries.

Storage batteries are beginning to have such a widespread use in lighting and power plants and on street railways that an accurate determination of their efficiency is necessary. At the recent meeting of the Institution of Electrical Engineers in Edinburgh, Scotland, Prof. W. E. AYRTON read a paper describing a very thorough series of experiments with the E. P. S. cells made by the Electrical Power Storage Co. These cells, generally considered the best in England, are formed of lead plates or "grids" in which are a large number of holes filled with minium. The dilute sulphuric acid employed has a specific gravity of 1170. There were 20 of these cells employed in the tests, the weight of each being made up as follows:

3 negative plates, 9¼ × 9¼ ins.	about	17 lbs.	2 oz.
2 positive plates, 9¼ × 9¼ ins.	"	11 "	8 "
Ebonite strips	"	0 "	8 "
Glass jar	"	7 "	8 "
Dilute sulphuric acid	"	23 "	2 "

The experiments were made with batteries of 10 cells, and were conducted with a constant current, maintained by varying the resistance.

The first group of 10 cells was charged with 9.05 ampères and discharged with 9.933, there being 4 discharges alternating with 4 charges, without intermission, for 4 days. One of the observers was always present, day or night, to keep the current constant, to take the necessary readings and to stop the charging when the P. D. (difference of potential) reached 2.4 volts per cell and immediately start the discharging. The P. D. limits were 2.4 and 1.6 volts for charge and discharge respectively. Then this group was charged with 4.519 ampères and discharged with 9.933 twice, 6 days being taken for the operation. These tests were conducted with all possible care, but the results were somewhat surprising, showing quantity efficiencies of 98 to 105 per cent. and energy efficiencies of 87 to 94 per cent. Experiments conducted on the second group of 10 cells in a different manner, but also with extreme care, gave quantity efficiencies of 102 to 111 per cent. and energy efficiencies of 90 to 103 per cent. These results showed conclusively that in tests of this nature, if secondary batteries be thoroughly charged before being tested, then 6 days continuous charging and discharging alternately with even the maximum currents allowed by the manufacturers fails to give the actual quantity or energy efficiency.

Convinced by these experiments that the period of charging and discharging must be increased in order to obtain reliable results, Prof. AYRTON and his assistants devised an automatic current regulator which broke and changed the currents as soon as the P. D. reached the limiting values. By this means the extremely tiresome manual regulation was avoided.

With this apparatus and a battery of only five cells, the charging and discharging was again begun. A steady current of nine amperès was maintained until the P. D. reached 2.4 volts per cell, and then the discharge was begun and continued until the P. D. fell to 1.6 volts per cell. After 12 days and nights of continual charging and discharging, the time rise of potential during the charge and the time fall during the discharge were repeated over and over again, so that when the time curves were drawn for the successive charges they exactly coincided, and the same for the discharge curves. The areas of these diagrams will thus give the watt-hours for charge and discharge.

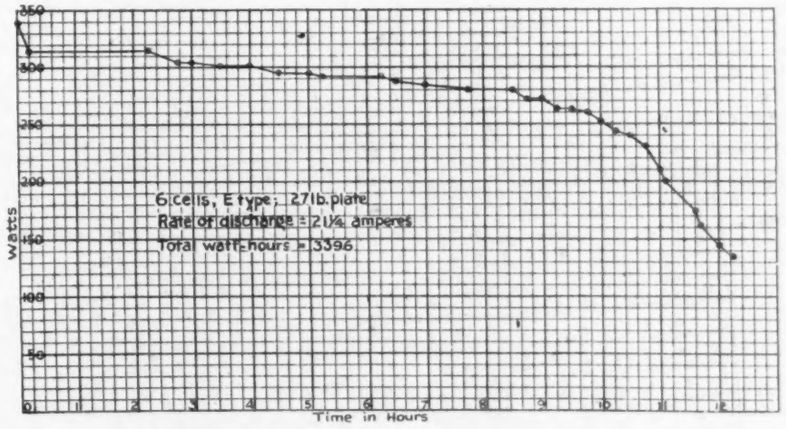
The results may be summarized thus:

Discharge.		Charge.		Percentage	
Ampère hours.	Watt hours per cell.	Ampère hours.	Watt hours per cell.	working efficiency. Quanity.	Energy.
115	221.8	117	256.2	98.3	86.5

After working for some time in this way the action became irregular and on examination it was found that the plates were badly scaled. This seemed to show that the cells were run too low and it was therefore decided to stop the discharge when the P.D. per cell reached 1.8 volts. After continually charging and discharging for 13 days, the cells reached a perfectly steady state and the following results were obtained:

Discharge.		Charge.		Percentage	
Ampère hours.	Watts hours per cell.	Ampère hours.	Watt hours per cell.	working efficiency. Quanity.	Energy
101.9	201.7	104.5	230.7	97.2	87.4

The figures may probably be considered as giving the steady working values for this size and type of



WATT-HOUR CURVE, MAIN STORAGE BATTERY.

cell; 230.7 watt hours are equivalent to 612,300 ft. lbs., and since the plates weigh 28 lbs. 10 oz. per cell, the working storage capacity is 21,390 ft. lbs. per lb. of plate.

In ENGINEERING NEWS for Dec. 7, 1889, the storage batteries invented by Prof. WM. MAIN and manufactured by the River and Rail Electric Light Co. were described and a table of results of tests given. Through the kindness of Prof. MAIN, we are enabled to give in this issue a watt-hour curve taken by Prof. CHANDLER and Dr. LANDY, of the Columbia School of Mines, from a six cell battery of this type. We are assured that this curve represents the average working of the latest type of battery; if this is so, as it undoubtedly is, it will be seen that the working storage capacity of the MAIN cells is 55,640 ft. lbs. per lb. of plate, more than twice that of the E. P. S. cells. The curve is also very smooth in its outline, showing that the stored energy is given out with perfect regularity and at a rapid rate.

THE QUESTION OF A SITE FOR THE COLUMBIAN EXPOSITION at Chicago is still an undecided one. The Lake front site has been given up on account of the great expense of preparing it for use, and the many conflicting interests involved. The directors, at a meeting on Sept. 26, adopted a resolution asking the South Park Commissioners to allow the use of Washington Park, "because it is the one site for an exposition." It was voted that a meeting be held on Sept. 9, at which the final choice of a site shall be made.

County Debts of the United States.

The Financial Condition of Counties is the subject of Census Bulletin No. 6, supplementing the records of State indebtedness given in Bulletin No. 7 (which was issued in advance of No. 6) abstracted in ENGINEERING NEWS of Aug. 16. The figures presented are given in detail for the whole country, for each State and for five groups of States and Territories.

The county debt of the United States has nominally (but not actually) increased since 1880, from 125.6 millions to 145.7 millions gross, or 16 per cent.; but it is gratifying to note that while the bonded debt has increased from 106.8 millions to 130.7, or 22 per cent., the floating debt has decreased from 18.6 millions to 15 millions, or 21 per cent. In this period the sinking fund has increased from 1.6 millions to 6.2, or about 345 per cent. This large percentage of increase is due to the fact that provisions for a sinking fund did not exist in many of the counties prior to 1880, but have since been made and carried out. If we add to the 1890 sinking fund the amount of cash in the county treasuries we have the total available resources 30.5 millions, and a net debt of 115.2 millions.

The following table shows the comparative figures for 1870, 1880 and 1890, so far as determined:

	1870.	1880.	1890.
No. counties report'g	2,251	2,436	2,728
Bonded debt	$157,995,880	$106,767,946	$130,734,959
Floating "	29,609,660	18,853,509	14,958,881
Gross "	$187,565,540	$125,621,455	$145,693,840
Sinking fund	..... (?)	1,593,869	6,174,859
Cash and other resources	..... (?)	..... (?)	24,294,096
Net debt	..... (?)	..... (?)	$115,224,885

By a very gross and misleading error in the *Bulletin* the net debt for 1880 and 1890, is compared on page 21 making *no allowance* for "cash and other resources" in 1880, simply because the records were not available and so showing an apparent decrease in net debt of $8,802,701 ($124,027,586 less $115,224,885) when there must have been some increase, unless the "cash in the treasury and other resources" of 1880 were only a third of what they were in 1890. This may have been nearly the case, however, so that still there may even be an absolute decrease since 1880, and there is certainly a gratifying and decided tendency to decrease, even in absolute amount, while in proportion to wealth the decrease is very decided.

It is not the fault of the Eleventh Census that the figures for the Tenth were incomplete, but such incompleteness is no excuse for the error or misstatement which we have pointed out, and which, we trust, will not appear in the revised figures.

Looking at the States in detail, we find that Vermont, Louisiana and Utah Territory have resources in excess of liabilities, but none of the States or Territories are entirely without county debt, save Rhode Island, whose counties have no financial responsibility. Vermont had no county bonded debt in 1880, and has not incurred any. Connecticut had $64,500, and has paid it all. New Mexico has increased her very small debt of $46,000 in 1880 to $1,559,000, or 3,277 per cent.; but the actual increase is insignificant in comparison with Kansas, which has increased its bonded debt from 7.4 to 14.2 millions, or 93 per cent. A slight reduction in the floating debt of Kansas lowers the total increase of her debt to the rate of 86 per cent., but she has the unenviable distinction of standing first in amount of gross debt, 14.8 millions, the position that Illinois held in 1880, with 14.3 millions against 11.8 now, a decrease of 18 per cent. Illinois stands second in total amount of debt, and her net debt is but 10.6 millions, against Kansas, 13.8. This heavy increase in Kansas debt is very possibly the result of many railway subsidies. It is to be hoped that the final report on indebtedness will give an analysis showing the nature of the debts. Regarding Vermont's gross debt it should be stated that it is now but $5,151, having been reduced 78 per cent., or over $18,000 in ten years. It is interesting to note that the total annual interest charges on these county debts is 7.3 millions, or an average of about 5 per cent.

The total number of counties in the United States is 2,809, of which it seems that but 2,728 are organized and keep accounts. Of these 2,616 made returns to Census Bureau, but it is thought that the delinquent counties are so insignificant that the totals are not materially affected by their omission. Of the 2,616 counties reporting 944 have no debt, while five have a debt of two millions and over.

An outline map of the United States and five sectional maps, present in a graphical way, the relative indebtedness of the States and of the counties within the States. On the United States map different symbols represent the bonded debt, gross debt and total available resources. The sectional maps show, by the aid of symbols, the relative and total indebtedness of the counties. A reproduction of the western sectional map is given herewith and will repay examination.

In our issue of Aug. 16, abstracting Census Bulletin No. 7, we gave figures showing that since 1880 our gross State indebtedness had decreased from 206.4 millions to 238.4, or about 20 per cent., and the net debt from 204.5 millions to 132.4, or 35¼ per cent. During the same period our net national debt has decreased from 1,022.5 to 923.4 millions, or 52 per cent. If the figures for county debts were complete a decrease in net debts of this class of from 2 to 4 per cent. would probably be shown. The census office

GROSS DEBT OF COUNTIES, NORTH CENTRAL AND NORTHWEST CENTRAL STATES, 1889-'90.

From Census Bulletin No. 6, on Financial Condition of Counties.

promises similar figures regarding the finances of municipalities and other minor civil divisions having power to contract debts and levy taxes. The gross debt of this character will probably show an increase which may prove to be large.

By groups of States the totals of gross debt stand as follows:

Geographical groups.	1880.		1890.		Inc. or dec.	
	No. Co's	Amount.	No. Co's	Amount.	Increase	Decrease
N. Eng	67	$2,726,877	67	$5,003,577	$2,276,700	.....
Middle	174	30,925,231	175	25,369,185	.....	$5,556,046
S'thern	1,095	24,56 ,013	1,178	25,271,132	711,119	.....
W'tern	1,061	66,956,113	1,220	86,775,302	19,819,189	.....
Terri..	39	453,221	49	3,274,644	2,821,423	.....
Total.	2,436	125,621,455	2,728	145 693,840	20,072,385	.....

Experience with Frogs and Switches.

At the recent meeting of the New England Roadmasters' Association at Boston, Mr. W. F. ELLIS presented a paper on the chief causes of the renewal of frogs and switches. We abstract it as follows:

Frogs and switches cause more anxiety to the roadmaster than anything else, for more wrecks, derailments, etc., are caused by them than by all the rest of the track. I advocate the use of spring rail frogs on the main line, except at terminals or through extensive yards. I admit the spring rail frog has been condemned in years past and has caused some wrecks, but I believe those frogs were not made as at the present time.

I would class the causes of renewal of frogs and switches as follows: 1. Sharp flanges, hollow treads or wheels out of gauge. 2. Neglect of trackmen. 3. Faulty construction.

[Mr. ELLIS here exhibited a drawing of the standard spring rail frog recommended by him. He also showed drawings of templates of worn wheel treads similar to those exhibited by him at a meeting of the New England Railroad Club last fall and shown in ENGINEERING NEWS, Oct. 19, 1889.]

The spring frog rail I prefer has the spring placed about 4 ft. from the point of frog toward the toe. A plate 36 ins. long, 18 ins. wide at one end, 24 ins. wide at the other, and ¾ in. thick, is riveted to the stock and point rails. Three filling castings are to be used, as shown. The one at the point is especially necessary. A stop fastened to this plate about 5 ins. ahead of the frog point allows the spring rail to move only to a flangeway not to exceed 2 ins. in width. From this stop a flat rod should extend about 3 ft. and be fastened to the spring rail at the end, being about 5 ins. from and parallel to the spring rail, and passing through a sleeve attached to the plate about 2 ft. from the stop. The purpose of this is to hold the spring rail down in its place and to a level with the point rails toward the heel of the frog.

The spring rail should be 58 ins. in length, fitting close to the frog for a distance of 38 ins. when in use for main line track, and curving to a 4-in. flangeway in the last 20 ins. The rigid wing rail should be longer than it is usually made, in order to properly bolt the point rails to it.

A spring rail frog thus made, if properly put in and taken care of, should be safe and economical. Formerly the spring rail extended back only about 20 ins. from the point of the frog and a hollow or double flanged wheel when tailing through the switch would strike the head of the spring rail, forcing it out beyond a 2-in. flangeway, no stops being used, then dropping off the point of the frog or breaking it and causing wrecks.

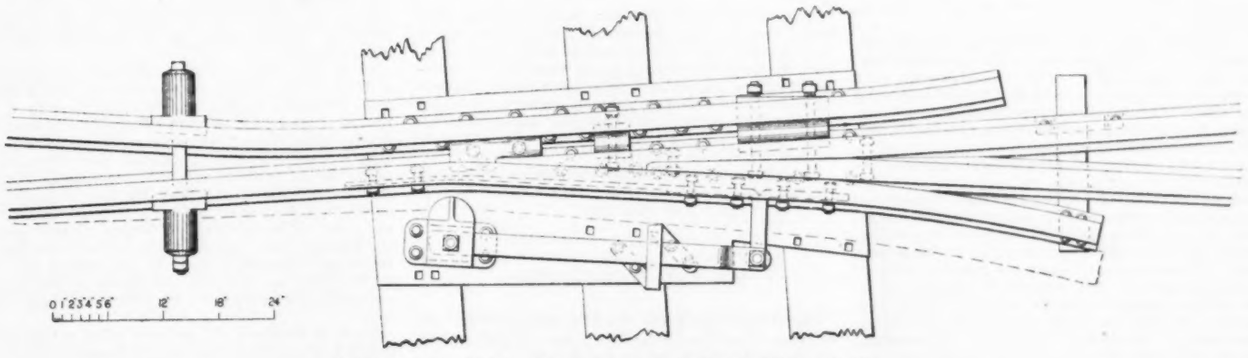
The greatest wear on a spring rail frog as now made is generally on the heel rail on the side track side where the outer part of the tread of wheels, good and bad, strikes it. This is because the other heel rail cuts into the tie more, owing to the greater traffic over it. The trackman's adze will cure the trouble. Guard rails opposite a spring rail frog should be watched and kept in good condition and at proper gauge.

A rigid rail frog wears most between a point 6 ins. ahead and one 12 ins. back of the frog point. This is caused by the wheels dropping into the depression on the wing, making increased wear as well as an uncomfortable jolt. This can be partially remedied by the renewal of this wing before the rest of the frog; but this should not be done after the frog point is worn too low. There is also considerable wear on the heel rail on the side track side, as in the spring rail frog. It is a waste of material to make rigid frogs too long, since they wear out so soon.

Frogs will also wear badly if out of line. If properly lined when put in, they may be knocked out by the use of poor ties under them, bad guard rails, or wheels running over them out of gauge. For a remedy I would advise the use of standard specifications to be attached to every order for frogs, to be used in inspecting when frogs are received from manufacturers or from the repair shop. In this way all frogs of the same angle may be made interchangeable.

The M. C. B. Association's interchange rules provide that car wheels may be 4 ft. 5 ins. to 4 ft. 5¾ ins. between backs of flanges, permitting ¾ in. variation, but *no* discrepancy in the gauge of guard rails. Wheels are allowed to run, however, of both wider and narrower gauge than the above. The road department could make a much more creditable showing if the cost of turning down some of the worn engine tires could be charged to it before they do so much damage.

In split switches the greatest wear is from the fourth or rear switch rod back to the point. The cause and remedy is the same as already stated for frogs. I would have plates under all the rails on every tie to the joint, and two braces ahead of the joint on the kick-rail side.



SPRING RAIL FROG, MADE BY THE RAMAPO IRON WORKS.

PERSONALS.

Mr. W. P. ROBINSON, Jr., has been appointed General Manager of the St. Joseph & Grand Island R. R.

Mr. W. H. FERGUSON, a large railroad contractor, of Evansville, Ind., died recently at Anderson, Ind.

Mr. E. T. REISLER has been appointed Roadmaster of the Delaware division of the New York, Lake Erie & Western R. R.

Mr. RUDOLPH HERING, M. Am. Soc. C. E., has been engaged to prepare plans of a complete sewerage system for Roanoke, Va.

Mr. R. H. EMERSON, recently connected with the Chicago, St. Paul & Kansas City Ry., has been appointed Master Mechanic of the Winona & Southwestern Ry.

Mr. W. IRVING WILLIS has just returned from Yucatan, where he has been in charge of the extension of the Merida, Progreso & Sotuta R. R., from Merida, to Izamal, about 70 kilometres.

Mr. S. B. HOVEY has been appointed Superintendent of the Western Division of the Chicago, Rock Island & Pacific Ry., vice Mr. W. J. LAWRENCE, who has resigned to take a position on the Colorado Midland Ry.

Mr. C. K. LAWRENCE has resigned the position of General Superintendent of the Eastern Minnesota Division of the Great Northern Ry. His successor will be Mr. F. M. MERRILL, formerly Division Superintendent of the Wisconsin Central R. R.

Mr. O. N. GARDNER, formerly City Engineer of Lincoln, Neb., and Mr. C. A. LABELLE, of the Ottawa Department of Public Works, have joined the engineering staff of W. R. COATS & Co., the water-works engineers and contractors at Owosso, Mich.

Mr. JOHN WESTINGHOUSE, senior member of the Westinghouse Co., of Schenectady, N. Y., manufacturers of agricultural implements, and eldest brother of GEORGE WESTINGHOUSE, Jr., of air-brake fame, died at Schenectady, Sept. 2.

Mr. F. H. CLEMENT, M. Am. Soc. C. E., has secured the contract for the Niagara tunnel for the company, Rogers & Clement, of which he is a member. The amount of the contract is not yet known, but it is certainly very large as the work requires a mile and a half of heavy rock tunneling.

Mr. A. GOTTLIEB, who has been selected as Consulting Engineer of the World's Fair at Chicago, was educated at Prague, Austria. With the exception of 7 years spent in Pittsburgh as President of the Keystone Bridge Co., he has always lived in Chicago. He has been connected with many of the largest bridge building enterprises in the Mississippi Valley.

Mr. R. L. JOHNSON, a graduate of the University of Georgia, and recently engaged in railway, tunnel, sewer and water-works construction under Mr. J. S WALKER, M. Am. Soc. C. E., of Birmingham, Ala., has received the Graduate Fellowship in Engineering, recently advertised in ENGINEERING NEWS, at the Vanderbilt University, being selected from a large number of candidates for the position.

NEW PUBLICATIONS.

BOOKS.

—*The Computation of the Magnetic Declination and the Annual Change, and the Desirability of the Establishment by the States of a True Polar Meridian and Standard of Length in Each County.* A paper read before the Southern Society of Civil Engineers, March 15, 1886, by J. FRANCIS LE BARON, C. E. Price, 50 cents.

The tables of magnetic declinations observed in Southern States given in this pamphlet are very valuable; they cost a great deal of time and labor to collate and prepare, and are here presented for the first time in an available form. To accommodate those wishing them we have copies for sale at this office.

—*Der Tunnelbau.* Ein Lehrbuch. CARL DOLEZALEK, Prof. of Engineering at the Royal Technical Institute at Hannover. Erste Lieferung. TH. MIERZINSKI, Hannover. Paper, 8v., pp. 96 and 9 plates.

This little pamphlet, the first installment of a large work on tunneling, is mainly devoted to a description of percussion rock drills. The types illustrated are mainly European; with the exception of an *old* form of Ingersoll tappet drill and the Wood drill made by the Howes & Phillips Iron Works in Newark, N. J., there is no mention of an American machine in that part of the book already published, which is equivalent to saying that the work is in this respect very defective. In view of the fact, noted in ENGINEERING NEWS of Aug. 16, that a complete Ingersoll plant was to be used in the Danube River improvements, this omission is not only a serious out an absurd one. We notice also a (seemingly) careful avoidance of all reference to DRINKER'S great work on tunneling. Nevertheless, the book is very complete in its description of the European drills, and will undoubtedly prove of interest to all who wish to become acquainted with the machines in use abroad, however much they may fall below our American types in efficiency and simplicity. The succeeding parts we trust we shall be able to notice more favorably.

—*The Tornado.* By H. A. HAZEN, Asst. Prof. U. S. Signal Office. New York: N. D. C. Hodges. 12mo, pp. 143. $1.

We judge it to be quite certain that this is by much the most careful and trustworthy book on tornadoes which exists. The very latest data have been compiled for it, and the author has personally contributed much new and

valuable matter, most of it with the eminently practical purpose of determining precisely what the loss by tornadoes is, how it can be guarded against, and how its burden on individuals can be diminished. As such, the book deserves, and doubtless will have, a wide circulation in the tornado districts.

The opening chapters of the work, confined to a very clear and well-digested summary of the facts, appearances, theories and objections to theories bearing on tornadoes, we will not attempt to review in detail. The nearly universal testimony is that tornadoes are accompanied by a loud, continuous roar, which it is difficult to explain as due to atmospheric causes, and it is strongly suspected to be due in some way to electrical causes, in other words to be a kind of thunder. It is well established that tornadoes will almost entirely denude fowls of feathers without killing them; an effect which it is impossible as yet to artificially imitate. It is not due to the passage of a vacuum, nor to swift motion of air past the fowl, for artificial vacuums, or blasts of air, or firing a cannon do not have a like effect.

To get at the actual loss by tornadoes Prof. HAZEN classifies them in order of violence as classes 1, 2, 3; 3 being the most violent class. He then details how he has made a careful division of all recorded American tornadoes between 1873 and 1888, inclusive, with the result that there were in all, in that time,

48	class 3 tornadoes, with	$9,650,000	loss.
988	" 2 " "	19,760,000	"
2,221	" 1 " "	3,555,000	"

The loss for the class 3 tornadoes was carefully estimated for each. The average loss by the others was placed at $20,000 each for class 2 and $3,000 for class 1. The only other list which has been extant, claiming to be at all complete, showed only 2,435 tornadoes, but the enormous aggregate of $041,282,500, or $386,564 each, as the total loss by them. It is conclusively proven that these figures are a gross exaggeration, the average loss by the 48 class 3 tornadoes, which has been carefully estimated, having been only $201,042 each.

Among the separate States, Illinois, Ohio, Missouri and Kansas stand first in losses, with 3.7, 3.0, 2.9 and 2.7 millions of loss respectively. Iowa (2-1), Wisconsin (1.9), Minnesota and Georgia (1.7), Indiana (1.6), Alabama (1.5), New York (1.3), Arkansas and Mississippi (1.2) and Pennsylvania (1.1) come next; and Michigan and North and South Carolina have had less than a million of loss each, making in all 17 States which have had enough loss to be tabulated.

Prof. HAZEN then takes up the question of tornado insurance, and by a valuable table contrasts the fire loss in each of the above States between 1876 and 1884 with the tornado loss. The result is very striking. Omitting New York and Pennsylvania, which are not properly tornado States, although their extent and dense population gives them a large aggregate loss, the average ratio of the tornado to the fire loss has been 1-14. In Kansas it has been highest, 1-3; but only Mississippi (1-5) and Alabama, Arkansas and Iowa (1-9) show a ratio as great as 1-10. Ohio is only 1-34 and Illinois 1-15.

Prof. HAZEN then concludes that in the fifteen leading tornado States the loss does not exceed 7 per cent. of that by fire, and hence that 8 to 10 per cent. increase of fire premiums would be enough to enable insurance companies to safely include tornado risks as well. There is, however, this serious difficulty in the way, that tornado losses are much more likely than fire losses to "come not in single spies, but by batallions." It is the exception that more than one risk is involved in a fire loss; it would be the exception when more than one risk was not involved in a tornado loss. Hence tornado insurance must become very general before heavy risks anywhere can be incurred by a single company. There is naturally more or less timidity, but Prof. HAZEN has doubtless done much in this little volume to hasten the day when tornado insurance will become general because obtainable at reasonable rates. This is the only country on the globe where tornadoes are so frequent as to make such insurance important.

REPORTS.

—*Report of Tests of a Compound Locomotive*, built by Baldwin Locomotive Works, Philadelphia, in service on the Baltimore & Ohio R. R., by Geo. H. Barrus, M. E. Pamp., 8vo, pp. 55, with illustrations and tables. Published by Baldwin Locomotive Works.

—*The Sewerage of Columbus, O.* Address of Col. GEO. E. WARING, June 23, 1890. With discussion. Pamph.

This address was a report, delivered to an assemblage of the citizens, and followed by a general discussion. Col. WARING was called upon, primarily, to say whether a proposed intercepting sewer would be large enough for the work it would have to do, but was afterwards asked to examine the whole system.

—*Report of the International American Conference relative to an Intercontinental Railway.* Washington, 1890. Large 8vo., pp. 214, 5 maps.

This report contains the reports of the various delegates upon the railways of their own countries, and an appendix containing a special report of Lieut. GEO. A. ZINN, Corps Engineers, United States Army, upon the railways of the Spanish-American republics, and the route for the proposed intercontinental railway.

—*Proceedings of the Association of Provincial Land Surveyors of Ontario, at its Fifth Annual Meeting, Toronto, Feb. 25-27, 1890.* Pamph.

Six papers were presented at the meeting, as follows: "Coast and Harbor Surveys in Hudson Bay and Strait;" "Compiled Plans;" "The Romney Tunnel Drain;" "Leveling;" "The Graphical Method of Calculating Strains;" "A Few Thoughts on Draughtsmanship;" "Water-works for Towns and Villages;" "Extra Stresses in Structures." An appendix consists of a biographical sketch of Col. CHEWETT, who was born in London, Eng., in 1753, was at one time hydrographical engineer for the East India Co., and afterwards Surveyor General of Upper Canada. The report contains a portrait of the General.

TRADE PUBLICATIONS.

How to Bore a Hole True.—"Waterman's Book about Nicholson's Horizontal Borer." Nicholson & Waterman Mfg. Co., Providence, R. I.

A little pamphlet describing in a light and humorous vein an admirable tool.

—*Catalogue of Steam Shovels and Excavators.*—Osgood Dredge Co., Albany, N. Y. Pamph., p. 22.

The novelties of this latest catalogue of this well known company are a dredge worked by an electric motor and a dredge arranged for working backward, digging out below its own bed.

—*American Bituminous Rock.* New England Paving Co., 19 Pearl St., Boston, Mass. Pamph., pp. 8.

This company is using the natural asphalt rock found in Central and Southern Kentucky, which is supplied at $10 per ton, or $1 per sq. yd., 2 ins. thick. This rock is of substantially the same composition as the foreign rocks but with the advantage that it has a sandstone instead of a limestone base. The pamphlet gives full directions for the use of the material.

—*Catalogue of Keuffel & Esser Co., New York*, 1890. Twenty-first edition; 8vo; pp. 290; over 300 illustrations. 50 cts.

The catalogue is bound in limp board covers and cloth back. The text and illustrations are well printed and well arranged, and are made easy of reference by a complete and carefully prepared index. Specially full assortments of field glasses, measuring tapes and fine drawing instruments are described, besides a number of novelties which seem to be of merit—"Paragon" scales, an architect's level provided with a compass, a 20-inch slide rule and a protractor T-square.

The catalogue is a thoroughly excellent one, and shows the instruments and materials manufactured by this well-known firm to good advantage

SOCIETY PROCEEDINGS.

American Association for the Advancement of Science.—The following officers were elected at the recent annual meeting held at Indianapolis:

President, Albert B. Prescott, Ann Arbor, Mich.

Vice-Presidents: A. Mathematics and Astronomy, E. W. Hyde, Cincinnati, O.; B. Physics, F. E. Nipher, St. Louis; C. Chemistry, R. C. Kedzie, Agricultural College, Michigan; D. Mechanical Science and Engineering, Thos. Gray, Terre Haute; E. Geology and Geography, J. J. Stevenson, New York; F. Biology, J. M. Coulter, Crawfordsville, Ind.; H Anthropology, Joseph Jastrow, Madison, Wis.; I. Economic Science and Statistics, S. Dana Horton, Pomeroy, O.

Permanent Secretary, F.W. Putnam, Cambridge, Mass.

Secretary of the Council, A. W. Butler, Brookville, Ind

General Secretary, Harvey W. Wiley, Washington, D. C

Auditors: Henry Wheatland, Salem, Mass.; Thomas Meehan, Germantown, Pa.

Secretaries of Sections: A. Mathematics and Astronomy, E. D. Preston, Washington, D. C.; B. Physics-A. N. Farlane, Austin, Texas; C. Chemistry, F. H. Norton, Cincinnati, O.; D. Mechanical Science and Engineering, William Kent, New York; E. Geology and Geography, W. J. McGee, Washington, D. C.; F. Biology, A. J. Cook, Agricultural College, Michigan; H. Anthropology, W. H. Holmes, Washington, D. C.; I. Economic Science and Statistics, B. E. Fernow, D. C.

Treasurer, William Lilly, Mauch Chunk, Pa.

National Electric Light Association.—The Twelfth Convention of this Association was held at Cape May, N. J., Aug. 19, 20 and 21. The first paper read was by Prof. J. P. Barrett, City Electrician of Chicago, on Electrical Industries and the World's Columbian Fair. The paper stated that about 430 separate companies or individuals might be expected to apply for space for electrical exhibits. The arrangement of exhibits for educational effect, as well as for the commercial advantage of the exhibitor, was advocated. On motion it was voted that a committee of five be appointed to secure adequate space and facilities for the exhibits of electrical industries and manufactures at the World's Columbian Fair.

The committee appointed to secure the removal of the duty on copper reported that over 500 signatures had been secured, and the chairman of the committee, Mr. G. M. Phelps, had presented it before the Ways and Means Committee, and argued for the abolition of the duty.

The advantages of liquid insulation for underground conductors were presented in a brief talk by David Brooks, of Philadelphia, and then a valuable paper was read by Dr. Henry Morton, President of Stevens' Institute, on the Dangers of Electricity. We abstract this paper elsewhere.

Dr. Louis Bell of the *Electrical World* opened a discussion on the candle power of incandescent lamps, stating that the present rating of these lamps was unsatisfactory, both on account of the variation in the candle power of different lamps of the same norminal capacity and on account of the difficulty in accurately determining candle power. He favored a classification by watts instead of by candle power. Mr. Alexander pointed out that while the kilowatt hour was undoubtedly the proper unit for the sale of electric light, it could not be introduced, because the general public could not comprehend it.

President Perry said that he had found that incandescent lamps nominally of 16 c. p. varied from 17.25 to as low as 6.42 c. p. A committee was appointed to report at the next convention on the proper classification of the lighting power of incandescent lamps.

A paper which excited much interest and some controversy was on "Municipal Lighting," read by M. J. Francisco, of Rutland, Vt. The paper aimed to show that the reports that Chicago, Ypsilanti, Topeka, and other cities having municipal lighting plants obtained their lights much cheaper than cities lit by private companies were based on faulty bookkeeping. Mr. Francisco stated that figures from 50 municipal lighting plants showed an average cost of operation of $119.24 per lamp per year. Figures from 365 electric lighting companies showed that the average price of street lamps is $118 per year. Other considerations make the contrast in favor of company rather than municipal management.

As is well known, Mr. Francisco is an avowed enemy of the movement for the establishment of municipal electric light plants. The influence of his paper was considerably lessened, however, by the statement of Mr. J. P. Barrett, City Electrician of Chicago, that of the figures regarding that city given by Mr. Francisco, only two items were correct.

Mr. A. J. De Camp. of Philadelphia, spoke on the value of details in the care and labor of electric light stations. Then followed a lengthy and valuable paper by H. L. Lufkin, of New York, on "A Proper Basis for Determining Electro-Motor Rates." The paper was accompanied by a large number of interesting diagrams, showing the variation of the load in electric motor service in a great number of different factories and works. He favored basing the charge for electro-motors not on the nominal capacity of the motor, but on the maximum amount of power used at any one time, modifying this where the maximum load on the motor was largely in excess of the average load. In the discussion on this paper, Mr. Edgar, of Boston, said that the plan of selling power by meter was in common use there.

Mr. H. M. Swetland, of New York, editor of *Power and Steam*, read a paper on Standards of Economy in the Generation of Power. He advocated the collection and accurate record of the various items of cost in power generation, in order that any one might know when he was doing well or ill, while intending builders of plants would have a substantial basis for their estimates of cost of operation.

Mr. Ed. F. Williams, of Beloit, Wis., spoke on Triple Expansion Engines. He estimated the additional cost over a compound of the same power at 20%, and the economy in fuel over that type at about the same rate. Assuming, then, that with coal at $3 per ton an engine uses an amount in a year equal in value to its first cost, it follows that a triple expansion engine will pay for its increased cost over the compound in a single year.

Reports of various committees were presented, and it was voted to hold the next meeting at Providence, R. I.

International Congress on Inland Navigation—Annual Convention.

(*Concluded from page* 189.)

In Section B, the most important paper was by Prof. OSBORNE REYNOLDS, of Owens College, on "the Action of Tides on Estuaries," which described a series of experiments made with models by a committee of the British Association.

The immediate objects of the investigation, he said, had no relation to any particular estuaries, but were directed to determine in what respects and to what extent the distribution of sand in the beds of model estuaries of similar lateral configuration was affected by the horizontal and vertical dimensions, and the relation which these bore to one another and the tide period, so as to place the laws of similarity on which the practical applications of the method depended on as firm an experimental basis as possible. As the result of six experiments made, it appeared—(1) That the rate of action was proportional to the number of tides; (2) that the first result of the tide-way was to arrange the sand in a continuous slope, gradually diminishing from high water to a depth about equal to the tide below low water; (3) that the second action was to groove this beach into banks and low-water channels, which attained certain general proportions; (4) that the slope arrived at after

16,000 tides was the same at high speed in both models working at corresponding periods; (5) that in both models the steepness of the actual slope increased as the tidal period diminished. Such results with regard to low-water channel as had been obtained from the experiments already made were not discussed, because they had been incidental to the immediate purpose of the experiments; they had, however, been carefully recorded for future reference. The same might be said of the manner of action of the water on the sand, were it not that these experiments had revealed a part taken by one of these actions, the importance of which did not appear to have been hitherto observed. This was the action known as rippling of the sand. In the experiments this action was seen to play an essential part in determing the rate at which the distribution of the sand was effected, while the result of this action—the ripple marks—formed a most conspicuous feature in the final distribution, as well as at all preceding stages. The ripple marks on the strands were too well known to need description, and there was nothing surprising that similar ripple marks should appear in the beds of the models. But although presenting a very similar appearance, and being about of the same size, the ripple marks seen in all the plans were essentially different in their origin and in the position they took in the *régime* of the sand in the models from that held by the observed ripple marks on the shore sands. This last was caused by the alternating currents produced by the small swell running inshore, while that in the model was produced by the alternating action of the tide. There might seem nothing remarkable in this, considering that these currents in magnitude and velocity were not dissimilar, but if the models were similar to the results obtained in estuaries the converse should hold, and the estuaries should be similar to the models. In which case they were face to face with a very striking conclusion, that in the estuaries there should be a ripple mark or sand wave, produced by the action of the tide, similar to that on the models and on a scale proportional to the height of tide in the estuary. Thus some of the ripples in the models were from hollow to crest as much as one-fourth the mean rise of the tide, the distance between them being twelve times their height. This in an estuary would mean 7 or 8 ft. high and 80 to 100 ft. in distance. These ripples in the model were almost confined to the surface of the sand which was below low-water mark, though in places their somewhat eroded ends protruded up the slope from the low-water channels. The existence of these ripples very much enhanced the effect of the water to shift the sand. On the smooth walls of the sand the current, which would be about 6 ins. a second, did not drift the sand at all except close to the ridge, and then there was no apparent effect till after 1,700 tides, when ripples were just beginning; yet when the ripple once formed in another 1,200 tides the top of the bar had spread to 12 ins. The ripples also served to show in which way any shift of the sand was taking place, as they had a steep side looking in the direction of motion, and when the slopes were equal it was an indication of equilibrium.

In the discussion of this paper, M. J. DE COENE, the French engineer in charge of the improvements at the mouth of the Seine River, stated that he believed large models to be of the greatest value to harbor engineers. He considered the experiments of Messrs. REYNOLDS and VERNON-HARCOURT proved conclusively that the effect of training walls could be studied at a small expense in this way and many costly blunders thus avoided.

Mr. W. H. WHEELER said that he regarded these experments as proving conclusively that the natural features of any estuary were due principally to the ebb and flow of the tides and not to storms or winds as was believed by some persons.

Mr. L. F. VERNON-HARCOURT contributed a paper in which he discussed the physical conditions affecting tidal rivers and the principles applicable to their improvement. He pointed to the variety of forms of tidal estuaries, and showed that the rivers which were most regular were also the most uniform in depth, among these the Thames, the Ribble, and the Clyde being the most noticeable examples. The Loire and the Gironde approximated to the same results, except at their contracted outlets. On the contrary, rivers presenting abrupt variations in width were very irregular in depth, as exemplified by the Tay, the Mersey, the Scheldt, and the Shannon, for with similar discharges the depth varied in inverse proportion to the width. He described the influences and conditions affecting tidal flow, and the influence of the fresh-water discharge of a river at much length, but justice can hardly be done to his paper in abstract.

Mr. E. LEADER WILLIAMS, Chief Engineer of the Manchester Ship Canal, read a paper upon that undertaking. He described the work as the outcome of a series of long investigations in Parliamentary Committees in the years 1883, 1884 and 1885, £15⁰,000 being spent by its supporters in obtaining the acts. He gave details as to the vast works which were being carried on along the course of the canal, and said that with the use of the electric light steamers would be able to navigate by night as well as by day. The whole length of the canal, 35½ miles, could be traversed in about 10 hours. The canal was being excavated through its whole length to a minimum width of 120 ft. at the bottom, and averaged 172 ft. wide at water level. The upper portion, from Barton to Manchester, was 170 ft. wide at the bottom and 230 ft. at water level. At the various locks the canal was widened out considerably, and would admit of vessels turning if necessary. The width adopted would allow of large steamers passing each other at any part of the canal, and where works were built on the side of the canal for manufacturing purposes the canal should be widened out to allow of shipping lying alongside wharves without interfering with the passage of vessels up and down the canal. The minimum depth of the canal would be 26 ft., the lock sills being 28 ft. below water level to allow of the future deepening of the canal by dredging. The total rise from the ordinary water level of the canal at Eastham to the docks at Manchester was 60 ft. 6 ins. That rise, divided between the 4 sets of locks, gave an average rise of about 15 ft. 1½ ins. To let off flood and other spare water (the paper proceeded) sluices are provided similar in size and design to the sluices erected at the mouth of the river Weaver. There will be 4 of these sluices erected by the side of the locks at Mode Wheel and Barton and 5 at Irlam. At Latchford only 3 are required, as the flood waters of the Mersey will flow down the river channel through Warrington from the point above Latchford where the canal leaves the river, taking an independent course inland until it enters the Mersey again at Runcorn. Near Warrington, where the railway lines of the London & Northwestern and Great Western railways cross the canal, they are being raised by the construction of high-level deviation railways (about 1¼ miles long on each side of the canal), so as to allow of shipping passing under the railway bridges. After the deviation railways are constructed the railway traffic will be turned on to them, and the canal will be cut through the existing lines, which will then be closed for through traffic. The railways between Warrington and Stockport and the Cheshire lines railways near Irlam require similar deviation railways at a high level, and all these works are now in a forward state. The total length of railway deviations being constructed is 11¼ miles. The railway viaducts over the canal are in most cases considerably on the skew, and the clear spans of the openings vary from 226 to 137 ft., these large spans being necessary to enable the full navigable width of 120 ft. to be maintained for the canal under the bridges. There are 2 high-level road bridges and 6 swing road bridges between Runcorn and Barton; the spans of these bridges are in all cases not less than 120 ft. The minimum headway under the high-level railway and road bridges is 75 ft. The swing bridges will be worked by hydraulic power, as well as the movable aqueduct, which will enable vessels with fixed masts to pass across the canal at Barton. This work will have two openings of 90 ft. each, which will be crossed by a long iron caisson resting on a central pier. The caisson will be filled with water to the same depth as the Bridgewater Canal, and boats will pass along it over the canal. When vessels have masts too high to pass under the caisson it will be opened like a swing bridge, the water being retained in the caisson by lifting gates at either end. Similar gates will be used at either end of the aqueduct leading to the movable caisson to maintain the water in the Bridgewater Canal. For the excavation of the canal nearly 100 steam excavators of various types have been employed, some of which have been constructed in France and Germany. To convey the earth to the spoil grounds, and for other purposes, 173 locomotives and 6,300 wagons and trucks are now employed, 223 miles of railway having been laid alongside or in the bed of the canal. The rate of excavation has varied from ¾ to 1¼ million cubic yards per month. As much as 2,400 cu. yds. have been excavated in 10 hours by the German excavators, but their average would be less than 2,000 cu. yds. Like the French type of excavators, they are land dredgers, suitable only for soft soil. The English excavators have in good soil at times reached nearly 2,000 cu. yds. per day, but their average in all soils would be about 700. They are, however, capable of excavating very hard material, and even rock, when powder is used in advance of the excavator. There are 194 steam cranes, 182 portable and other steam engines, and 209 steam pumps employed on the works, and they consume about 10,000 tons of coal per month. The deepest cutting is near Runcorn, where for a short distance the depth is 66 ft. The largest cutting is at Latchford, where for a distance of 1¼ miles the depth averages 55 ft. The slopes of the cuttings vary with the nature of the soil, from 1 to 1 to 2 to 1. In the rock cuttings the sides are nearly vertical. The total amount of excavation in the canal and docks amounts to about 40,000,000 cu. yds., 10,000,000 cu. yds. of which is sandstone rock. (See ENGINEERING NEWS, Dec. 14, 1889, and Jan. 11, 1890.)

The papers in Sections C and D, although mainly statistical, have considerable interest to American engineers as showing the extent of inland navigation abroad.

M. P. HOLTZ, chief engineer of bridges and highways, Paris, accordingly gave a *résumé* of a paper written by him on "The condition, working and expenses of navigable roads in France." His paper was divided into three chapters, of which the first two were historical. In France, as elsewhere, inland navigation is traced to remote times, and its progress has been somewhat slow. In the third chapter, devoted to the administration and maintenance of the French canals, it was stated that the navigable ways, natural or artificial, belong to the national public demesne, inalienable and imprescriptible. It is the State which administers directly the collective net of navigable ways, and, in particular, all the great lines of navigation. The harbors for loading and unloading the goods are distinguished as private and public harbors. The former are by far the more numerous; they serve for the industries in their neighborhood, at whose expense they are built. Certain canals really form one continuous harbor, and in this way important service is rendered to navigation. The public harbors, on the contary, form part of the dependencies of the navigable route, and belong to the State; but upon parties interested devolves the cost of furnishing them with the necessary apparatus, reserving the right of making up for their disbursements by levying a tax upon the public, according to an approved tariff. Still, with the exception of the Villette basins, which belong to the city of Paris, the contrivances of public harbors are in general insufficient. This circumstance is accounted for to a certain extent by the existence of contrivances for private harbors, but it is none the less to be regretted. Within recent years, and particularly since the year 1879, the canal system in France has developed to a wonderful extent. On some of the principal routes the average tonnage on the entire course amounts to and even exceeds 3,000,000 tons; the traffic of the harbors at Paris, amounting to nearly 6,000,000 tons, vies with that of great maritime ports. With this increase there is a constant and proportionate reduction in the cost of freight. On a total tonnage of about 1,990,000 ton-miles, each thousandth part of reduction in the cost of freight brings the country a yearly saving of more than $600,000. This reduction cannot be estimated at less than five thousandths in 10 years, thus making a yearly profit of $3,000,000.

Chevalier LUIGI, engineer of the Italian Government staff, read an abstract of a paper by Commendatore GAETANO BOMPIANI, President of the Superior Council of Public Works in Italy, on the subject of the management and expenses of the working of inland navigation in Italy. It was stated in the paper that the management and superintendence of the lines of inland navigation in Italy depend upon the State, with the exception only of the Pontini canals, which are dependent upon an agricultural drainage association. The cost of the ordinary and extraordinary maintenance of the waterways, with the exception of the Pontini canals, is met entirely by the State. The direct interference of the State with the inland waterways of Italy is justified because they supply several public wants, viz., navigation, irrigation, guarding against flooding, and the drainage of marshy lands, and it is necessary that the waters of these lines of navigation should be under the immediate direction of a public authority. The works of maintenance are under the direction of the engineers of the Royal Corps of Civil Engineers, and under the superintendence of a special staff for hydraulic works. The expense of the ordinary maintenance of navigable rivers executed in the direct interest of navigation is somewhat small; it averages $72 annually. The cost of the ordinary maintenance of the principal navigable canals per kilometer annually is divided as follows: Maintenance of artificial works, $144; maintenance of the canal banks and towing paths, $36; excavation and maintenance of the way, $83; cost of superintendence and sundry charges, $12; annual cost per kilometer, $275.

Herr SYMPHER, engineer to the German Government, gave a *résumé* of a paper on German waterways from 1875-85. He submitted two charts illustrative of the position of goods traffic on the German waterways in the years 1875 and 1885 respectively. The charts showed that as a result of the improvements which have been made in the condition of the large German, and more particularly the Prussian rivers, there has been an extraordinary development of internal navigation in Germany, in spite of the extension of the railway lines. On the testimony of experts, France has hitherto been regarded as *par excellence* the country of water communication. In spite of adverse geological and hydrological conditions, she has constructed an artificial net of waterways which is the admiration of Europe; but Herr SYMPHER pointed out that though the water transit of France is great and on the increase, it is far exceeded by the German, which in 1885 rose to double the French. In size of waterways, as well as in their economic value, Germany, he said, might be considered first in Europe, though she might not be before Russia, whose statistics were not freely published. The increase had been particularly great on the large waterways. Indeed, it was apparent that only such waterways as were able to accommodate heavy ships like those on the Elbe or Oder were needed in Germany.

Col. A. M. LINDGREN submitted a report on the canals of Sweden, which were 31 in all, including 11—such as those of Väddo and Strömma—without locks. The canals are for the most part constructed in the bare rock. Only a limited number of them have been built on an artificial foundation, composed principally of an inverted arch of pile-work or timber. The locks are built on blocks of granite, of sandstone or calcareous stone, fastened by mortar made of Portland cement or such cements as those of Berg or Fälhagen. The framework and groundwork of the lock gates are generally made of cut granite, most of it in large blocks.

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GEO. H. FROST.....BUSINESS MANAGER

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COMING TECHNICAL MEETINGS.

Engineers' Club of Philadelphia.—Next meeting, Sept. 6. Secy., Howard Murphy, 1112 Girard St.

Civil Engineers' Club of Cleveland.—Next meeting, Sept. 9. Secy., C. O. Palmer, 22 Cedar Ave.

Roadmasters' Association of America.—Eighth annual meeting at Detroit, Mich., beginning Sept. 9.

Civil Engineers' Association of Kansas.—Next meeting, Sept. 10. Secy., J. C. Herring, Wichita, Kan.

Engineering Association of the Southwest.—Next meeting, Sept. 11. Secy., Olin H. Landreth, Vanderbilt University, Nashville, Tenn.

Western Railway Club.—Next meeting, Sept. 16. Rooms, Phenix Building, Chicago.

Engineers' Society of Western Pennsylvania.—Next meeting, Sept. 16. Secy., S. M. Wickersham, Pittsburg, Pa.

Engineers' Club of St. Louis.—Next meeting, Sept. 17. Secy., W. H. Bryan, 30 South 7th St.

Boston Society of Civil Engineers.—Next meeting, Sept. 17. Secy., S. E. Tinkham.

American Society of Civil Engineers.—Next meeting, Sept. 17. Secy., John Bogart, 127 E. 23d St., New York.

New York Railway Club.—Next meeting, Sept. 18. Rooms, 113 Liberty St.

Engineers' Club of Cincinnati.—Next meeting, Sept. 18. Secy., J. F. Wilson.

Boston Society of Engineers.—Next meeting, Sept. 17. Rooms, 67 Washington Street.

Association of Civil Engineers of Dallas.—Next meeting, Oct. 3. Secy., E. K. Smoot, Elm and Austin Sts.

Civil Engineers' Society of St. Paul.—Next meeting, Oct. 6. Secy., G. L. Wilson.

Western Society of Engineers.—Next meeting, Oct. 7. Secy., J. W. Weston, 230 La Salle St., Chicago.

American Society of Railway Superintendents.—Annual meeting at New York on the day preceding the fall meeting of the General Time Convention. Secy., C. A. Hammond, 350 Atlantic Ave., Boston, Mass.

BY an annoying typographical error we were made to say last week, in the last line of our article describing the Fisher track jack, that "the screw and bed plate are of *cast* iron, and all the other parts of cast steel," when what was intended, and what was written in the manuscript was: "The screw and bed plate are of *wrought* iron, and all the other parts of cast steel." The accident of the proof not reaching the writer of the article, but being read merely for errors of form, not of sense, prevented this very obvious error, due to some careless compositor, from attracting attention. We trust and believe that the error can have deceived no one, it being so obviously absurd that cast iron in any form should be used about such a device. As a matter of fact, the bed plate is of wrought channel iron, the same as is used for the base plate of the Fisher rail joint; and the right and left screw is of the best double refined wrought iron.

WHETHER or not there is any real advantage in the use of collision posts at the ends of bridges is a question on which there is still much difference of opinion. As many of our readers are aware, Mr. W. B. D. HOWE, Jr., Chief Engineer of the Savannah, Florida & Western system, has done much intelligent work in the way of determining the actual efficiency of re-railing devices, with the result that he is extensively introducing them. He does not use collision posts, however, and in regard to them writes us as follows:

> It seems to be very doubtful whether the stripping out of the derailed trucks would prevent the following cars from being precipitated against the bridge unless the post was placed at a much greater distance than is, I believe, customary. It is still further doubtful, I think, whether the post would stand the shock. Some years ago we had a wild train consisting of an engine pushing five or six box cars run through this yard and onto a track which terminated against a brick wall about 4 ft. 6 ins. high, retaining the earth of the street. The cars struck this wall, knocked it down, ploughed through the earth backing for some distance, and partially demolished a building on the opposite side of the street, 130 ft. from the brick wall. Some of the cars, as I remember the circumstance, left their trucks near the wall, while the bodies were pushed entirely across the street, and struck the house as above stated. This operates to shake my faith very greatly in any collision post that would ordinarily be used. We cannot provide against all contingencies, and if we can take care of all derailed cars within the limits of our guard I shall feel that we have accomplished as much as could be expected. Beyond the limits of the floor of the guard timbers a car would fare pretty badly, bridge or no bridge.

The argument is certainly a forcible one, and the conclusion expressed in the last few lines quoted, not unjustifiable. Certainly, in the existing state of practice, no one can be justly accused of negligence for not using collision posts; yet, after all, what does the bank wall incident just quoted prove? The wall served instead of a collison post, but with the disadvantage of having a flush bank of earth above it. The cars lost their trucks, but the bodies pushed on across the street and did some damage. But had there been no flush bank of earth behind the wall would they have done so? We doubt it. Or again, had there been neither wall nor bank, but only a road-bed flush with the rails, would not the cars have been likely to do far more damage than they did? We fully agree that a collision post is always of doubtful efficacy, acting as it does only on mildly erratic cars; but we are unable to see how it can in any case aggravate a disaster, while it may easily mitigate it.

POLITICS seems to be getting badly mixed with the management of the Rochester, N. Y., waterworks. The works are owned by the city, and for years Mr. J. NELSON TUBBS was the engineer and superintendent. In fact, he designed the works, and we believe he was connected with them from the beginning of their construction in 1872 until quite recently, when he resigned his position. Since his resignation Mr. GEO. W. RAFTER has been Acting Chief Engineer. At a recent meeting of the Executive Board a member moved that a chief engineer be elected, the object of the motion being to take the works out of Mr. RAFTER'S hands, as is shown by the statement of the member of the board who made the motion, for when asked for a reason for Mr. RAFTER'S removal he replied that he had "no objection to going on record as in favor of appointing a Democratic engineer." Whereupon, according to the Rochester *Herald's* report, a "Republican member of the board said this was so important a matter that politics should not be introduced." The gravity of this instance is better appreciated when it is known that for over a year an attempt has been under way to devise some acceptible means of increasing a dangerously inadequate water supply. The city is dependent upon a single conduit line some 30 miles long, and 36 and 24 ins. in diameter in different parts of the line. The conduit has been credited with a carrying capacity of 9,293,000 galls., but recent examinations and measurements by Mr. RAFTER have shown that it actually carries but 6,700,000 galls., owing to loss of head and diameter by obstructions at various points. Messrs. FANNING and FTELEY reported upon an additional supply some time ago, and recommended a new gravity conduit. The former chief engineer, Mr. TUBBS, differed from the experts, and recommended a combined gravity and pumping supply. It seems probable that it was partly owing to this difference of opinion, and partly to some aspersions regarding his efficiency as an engineer, that Mr. TUBBS resigned, a step not at all surprising when we consider the long term of office which he had held, and the fact that he was the original engineer of the works, and had designed and carried out their improvements. But Mr. RAFTER concurs with the report of Messrs. FTELEY and FANNING, and in the face of this and of the present needs of the works, with which Mr. RAFTER seems familiar, a city official has no objection to "going on record" as opposed to Mr. RAFTER'S continuance in office, simply because he is a Republican!

Wave Pressure on Exposed Structures.

Now that the contract for the proposed Diamond Shoals lighthouse has been awarded, so that no personal interests are affected by some technical questions involved in it, it may not be unprofitable to briefly review one very serious, not to say fundamental, question involved therein, viz., the proper allowance to be made for the action of the waves on the structure and its foundations. There was evidently a decided contrast of views in regard to this question among the bidders on the structure, all of whom were engineers or contractors of high reputation. Thus, Mr. LINDENTHAL assumed, if we are correctly informed, that the structure might under conceivable circumstances be exposed to the action of breakers exerting as high a pressure as 6,000 lbs. per sq. ft., and as he desired to design a structure which should be safe under all conceivable circumstances, he allowed that pressure as coming against his concrete monolith. For like reasons he carried down his structure 80 ft. in diameter to 125 ft. below low water, these among other differences causing his bid to exceed those of the other three bidders three or four fold.

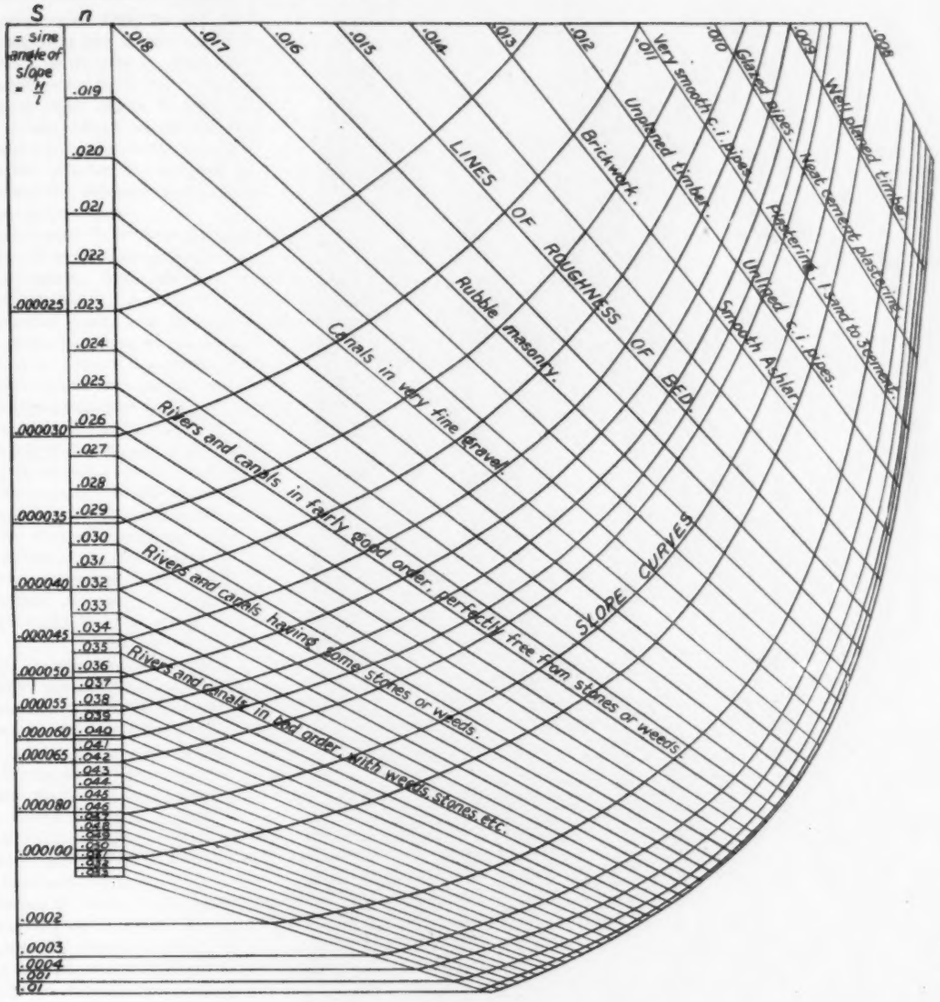
On the other hand, all of the other three bidders evidently assumed much less wave action. The comparative depths below low water and diameter at the water line of the other three bids stood as follows, as shown in our issue of July 26:

	Depth below L. W. Ft.	Depth below bottom. Ft.	Diameter at L. W. Ft.
Wm. Sooysmith	64	40	36
Theo. Cooper & Co	75	51	40
Anderson & Barr	124	100	45

We are left in ignorance as to the precise motives which governed the designers in adopting their particular proportions except in the case of Mr. COOPER, who submitted with his bid a memorandum discussing the stability of his structure, published in ENGINEERING NEWS of Aug. 2 *et seq.*

Mr. COOPER'S fundamental assumptions, as there set forth, were as follows:

1. An average wind pressure of 50 lbs. per sq. ft. over the whole projected area of the tower; with which we have nothing to do.



DIAGRAMS OF VARIOUS
HYDRAULIC FORMULAS
FOR APPROXIMATE USE.

COMPILED BY

J. LELAND FITZGERALD, M. AM. SOC. C. E.

(The diagram for the Kutter Formula is by the authors of that formula, Messrs. Ganguillet and Kutter.)

EXPLANATION AND DIRECTIONS.

DIAGRAM. I. Value of c in Kutter's Formula, $v = c\sqrt{RS}$,

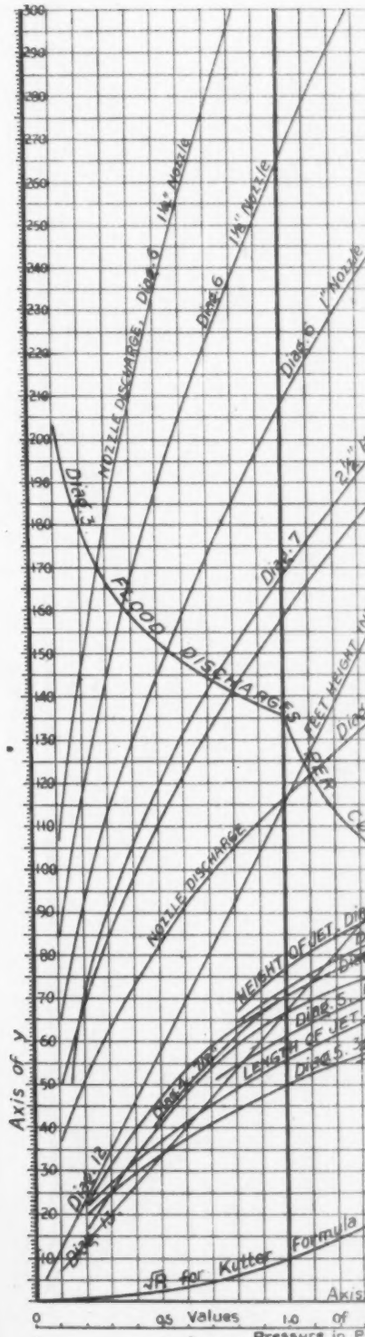
$$\text{in which } c = \frac{41.6 + \frac{1\,811}{n} + \frac{.00281}{S}}{1 + \left(41.6 + \frac{.00\,81}{S}\right)\frac{n}{\sqrt{R}}}$$

1. In the main diagram, find R (the hydraulic mean radius) on axis of y, first dividing its scale by 10. Follow along horizontally to the curve for $\sqrt{R}$ for Kutter formula, then down to axis of x (being sure not to mistake the scale line for the axis of x). Hold the point obtained, which call a.

2. In the side diagram, find the intersection of the given values of n (coefficient of roughness) and of S (sine angle of slope, $= \frac{H}{l}$), which call b.

3. Connect the points a and b by a right line, whose intersection with the axis of y will give the value of c, and this, $\times \sqrt{RS}$ gives the velocity in feet per second.

Example: (From Trautwine, page 279a, 13th ed.) R = 20, S = 0.00005, n = 0.03. 1. Follow along horizontal line 200 (which ÷ 10 = R) to the curve marked "$\sqrt{R}$ for Kutter Formula;" thence down to axis of x (not to scale line below t) for point a, which hold at 4.47. 2. In the side diagram find intersection of lines n = 0.03 and S = .00005, giving point b. 3. Connect a and b by a right line, which cuts the vertical scale at 96, the value of c required. Then $96\sqrt{RS} = 96\sqrt{.001} = .0316 \times 96 = 3.03$, the required average velocity in feet per second.



From the same diagram, given any th
by obvious methods.

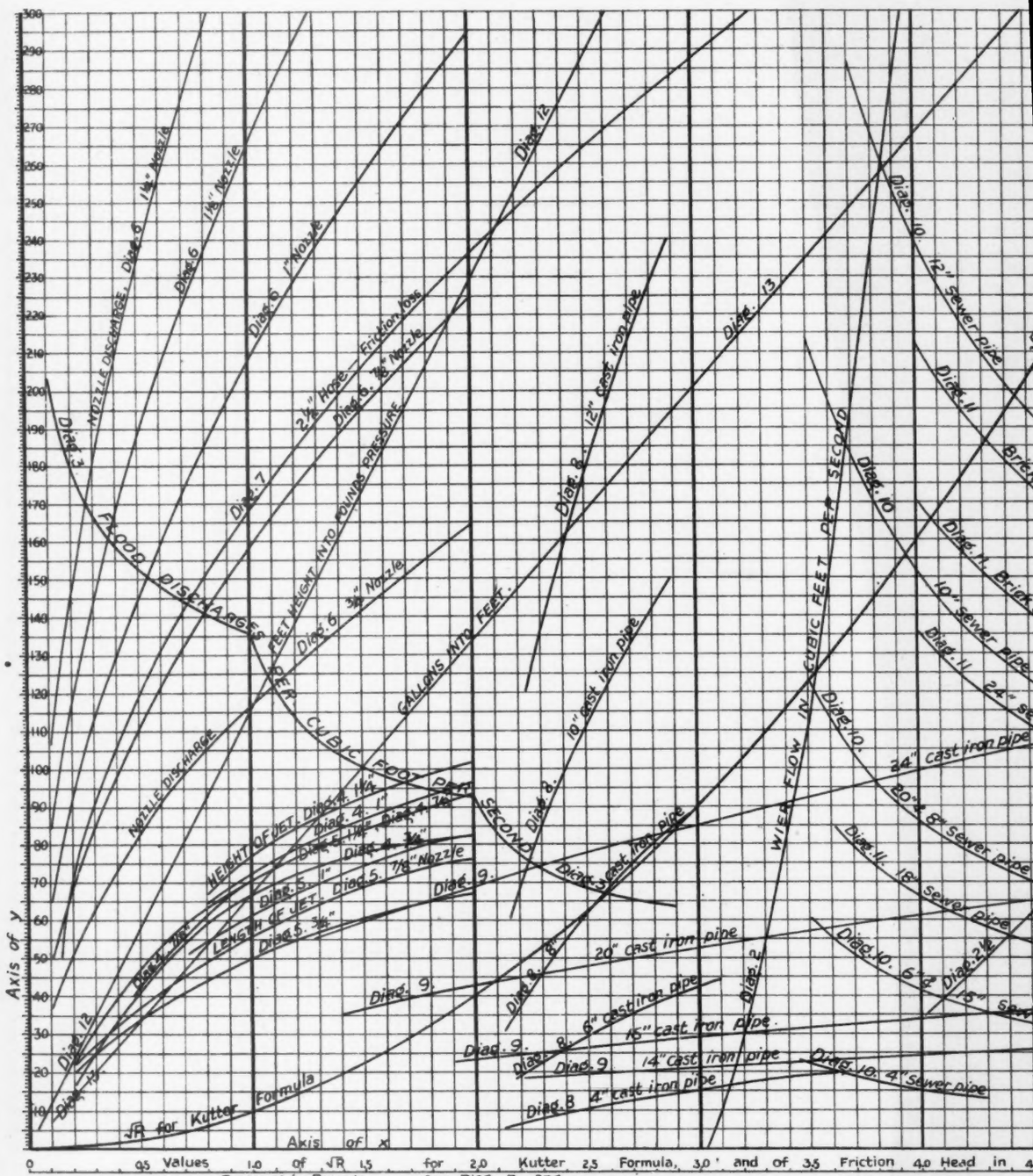
DIAGRAMS 2 and 2½. Trautwine's F
Find H on weir on given scale for axis of
scale by 10 for Diagram 2, but not for Dia

DIAGRAM 3. Fanning's Formula for
given horizontal scale (axis of x); flood dis
(axis of y).

DIAGRAM 4. Freeman's Formula for
horizontal scale; height of jet in feet fro

DIAGRAM 5. Freeman's Formula for
in. on given horizontal scale (at base of pl

DIAGRAM 6. Freeman's Formula for
given horizontal scale; Q in gallons per s



From the same diagram, given any three of the four variables, n, S, R and c, the other can be determined by obvious methods.

DIAGRAMS 2 and 2½. Trautwine's Formula for Flow over Weirs; $q = 3.33 \times (l = 1) \sqrt{h^3}$, all in feet. Find H on weir on given scale for axis of x; q discharged in cubic feet per second on axis of y, dividing vertical scale by 10 for Diagram 2, but not for Diagram 2½.

DIAGRAM 3. Fanning's Formula for Flood Discharges, $Q = \frac{200\ M^{\frac{4}{5}}}{M}$. Find square miles of area M on given horizontal scale (axis of x); flood discharge, Q, in cubic feet per second per square mile, on vertical scale (axis of y).

DIAGRAM 4. Freeman's Formula for Height of Jets from Hose. Find pressure in lbs. per sq. in. on given horizontal scale; height of jet in feet from vertical scale.

DIAGRAM 5. Freeman's Formula for Horizonal Length of Jets from Hose. Find pressure in lbs. per sq. in. on given horizontal scale (at base of play-pipe); distance reached from vertical scale.

DIAGRAM 6. Freeman's Formula for Quantity Discharged by Nozzle K. Find pressure in lbs. per sq. in. on given horizontal scale; Q in gallons per second on vertical scale.

DIAGRAM 7. Ellis' Formula
vertical scale; loss of pressure

DIAGRAM 8. Fanning's For
pipes. Find flow in cubic feet
horizontal scale.

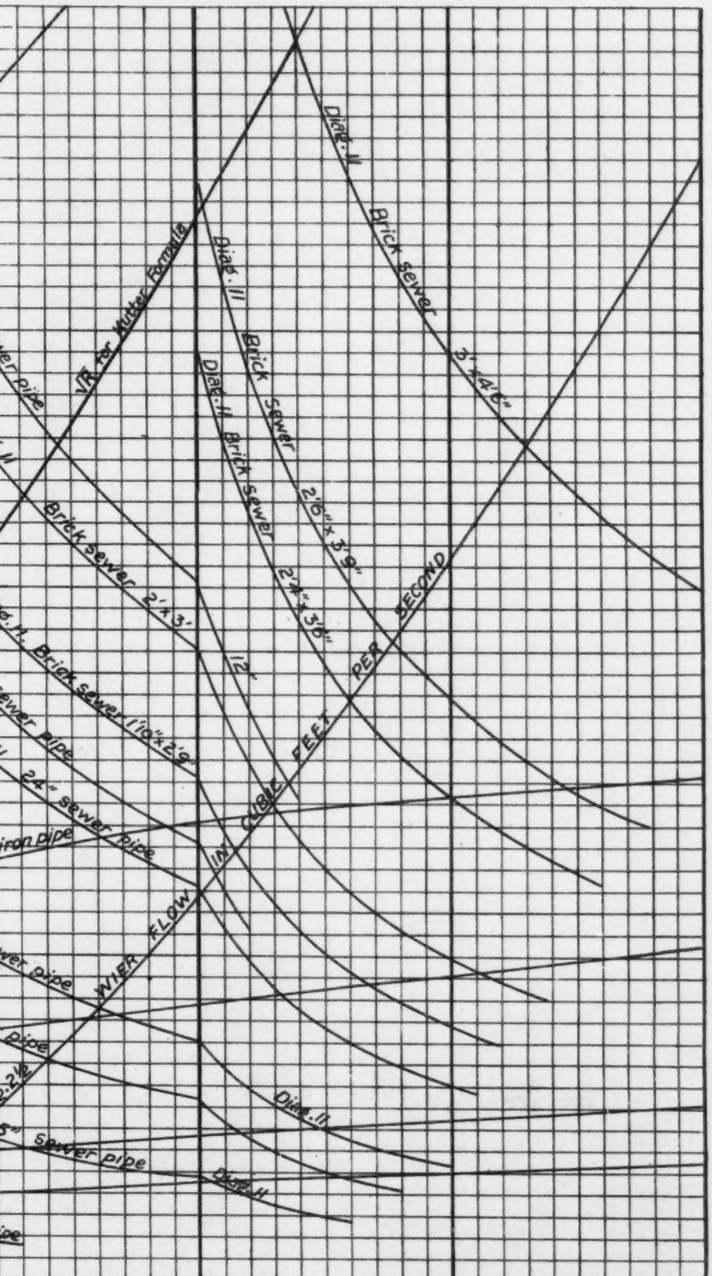
DIAGRAM 9. Same formul
scale, first multiplying it by 10;

DIAGRAM 10. Latham's Fo
scale; discharge in cubic feet p

DIAGRAM 11. Same formu
feet per minute on vertical scal

DIAGRAM 12. Pounds Pre
= ft. of head.

DIAGRAM 13. Gallons into



d in 4.5 Feet for 5.0 Diag. 9. 5.5 6.0 6.5 7.0

Wier 1.5 in Feet 2.0 for 2.5 Diag's. 3.0 2 and 2½ 3.5 4.0

Diag's. 150 10and11. 200 300 400 500 600 700 800 900 1000 1100 1200

2500

in 2.5 Feet 3.0 for 3.5 Diag. 8. 4.0 4.5 5.0

' Formula for Friction Loss in 2½ in. Rubber Hose. Find discharge "q" per minute on pressure for each 100 ft. in length in lbs. per sq. in. on given horizontal scale.

ning's Formula for Fnctional Head in Feet for Flow in Clean Cast-iron pipe, 4 in. to 12 in. ubic feet per minute on vertical scale; friction head in feet for each 1,000 ft. on given

e formula as 8; 14 in. to 24 in. pipes. Find flow in cubic feet per minute on vertical it by 10; friction head in feet on given horizontal scale.

ham's Formula for Sewer Discharge, 4 in. to 12 in. pipes. Find slope on given horizontal bic feet per minute on vertical scale.

ne formula as 10, brick sewers. Find slope on given horizontal scale; discharge in cubic tical scale, multiplied by 10.

unds Pressure into Feet of Head. Given horizontal scale = lbs. pressure; vertical scale

ons into Cubic Feet. Given horizontal scale = gallons; vertical scale = cubic feet.

CHAS. HART & SONS, LITH., 38 VESEY ST., N.Y.

2. A wave pressure of 3,090 lbs. per sq. ft. as a maximum, being that due to the static head of rollers 24 ft. high, as we take it, *plus* the height to which such rollers are liable to rise in impinging against a wall at right angles to their pressure, making 48 ft. of static head in all, the weight of sea-water being taken as 64.3 lbs. per cu. ft., and nothing whatever allowed for dynamic action of the waves beyond the increase of static head due to their motion, as just noted.

This last maximum is reduced (*a*) by one-half for the average of depth, bringing it to 1,545 lbs., (*b*) by one-half again, from the fact that the structure is cylindrical and normal to the current only at its central point, and (*c*) by one-third again, owing to the fact that, whereas the crest of the wave, when it touches the normal surface, is liable to rise to twice its own height, it reaches a much less elevation at all other points, which it does not impinge against normally, the decrease being gradual according to the amount of reflection. The total effect of these reductions is to reduce the estimated average pressure on the projected area of the whole tower to $\frac{1}{2} \times \frac{1}{2} \times \frac{1}{3} \times 3{,}090$ lbs. $= 515$ lbs.

This force Mr. COOPER considers to be applied over an area of 760 sq. ft., the center of pressure being not above high water, which is equivalent to allowing a vertical distance of 10 ft. each way from the high-water line, as acted on by wave pressure.

So far as can be judged from the designs in the absence of any distinct statements, Mr. SOOYSMITH'S design made somewhat less allowance for force of the waves than Mr. COOPER'S, and Messrs. ANDERSON & BARR'S, the adopted design, considerably more. We have no knowledge, however, of the assumptions made in regard to any one of the four designs, except those above quoted.

Are those allowances sufficient for a case of this kind? To determine this, let us first run over certain general facts and theories:

The calculations of wave force are best understood by first noting the motions of a particle of water on or near the ocean's surface at a place where the depth is so great that there is no drag due to the friction between the bottom and the water. In such a spot it is now universally admitted that during the progress of a wave the particles of water move in an elliptical orbit, which approaches very closely to a circle near the surface. The wave itself, *i. e.* the motion that we see, is very different from the motion of a particle of the water, *under such conditions.* It is also believed, on both experimental and mathematical grounds, that the period of a wave, or the time it takes any crest to travel to the position of the preceding one, is equal to the period of the particles of water in their orbits. From this it follows that the mean speed of a particle has the same ratio to the speed of the waves that the perimeter of the ellipse has to the wave length.

Bearing this in mind, it is very easy to ascertain the possible impact from waves to which the sides of a vessel or other body may be subjected. The greatest height of a wave that has been accurately observed is 43 ft. from crest to trough, corresponding to a wave length of about 600 ft. The velocity of the particles of water near the surface would then be expressed by the equation:

$$v = \frac{2\pi \ 21.5}{600} \times \text{velocity of wave.}$$

The velocity of a wave in the open sea has been proven by RANKINE and others to be approximately equal to that acquired by a heavy body in falling a distance equal to a thirteenth of the wave length. In the present case this would be about 54 ft. per second. Hence the velocity of a surface particle in its path would be $54 \times 43\pi \div 600 = 12$ ft. per second, nearly.

The impact of a jet against a fixed surface at right angles to its motion is $r\ A\ v^2 \div g$, where r is the weight of a unit volume of the fluid, A is the sectional area of the jet and v its velocity, all in the same unit.

In our case, the expression in feet becomes $62.5 \times 1 \times 12^2 \div 32 = 280$ approximately. Hence, the maximum pressure per square foot due to wave action alone *at sea* will probably not exceed 300 lbs. But this pressure will also be accompanied by that due to the direct pressure of a heavy gale or a hurricane, which must also be taken into account.

This process of calculation cannot be followed in harbor or lighthouse designing, however. In the first place the velocity of the wave itself is much greater in shallow water, and in the second place the velocity of the particles of water is no longer due simply to a rotation in an elliptical orbit. The preceding laws hold only when the water is about as deep as the length of a wave, or several hundred feet. Any person accustomed to surf bathing does not need to be told that the whole upper surface of the water moves forward, with great speed on the crests, and with hardly any in the troughs; while there is a constant undertow setting out from the shore. An experienced swimmer takes advantage of this when caught in a heavy undertow and put forth all his strength when in the crests and simply floats in the troughs of the sea.

Now if we assume that the surface of the sea in a harbor or on a bank, moved forward with a velocity equal to that of the wave, we arrive at some interesting results.

When the depth of water is only a few times the height of a wave, the velocity of the wave is equal to that of a heavy body falling a distance equal to *half the depth of the water plus three-fourths the height of a wave.** At Wick, Scotland, where the depth of water at the breakwater is a trifle over 60 ft., waves of 40 ft. were observed by Mr. THOMAS STEVENSON, the engineer of the harbor improvements. The velocity of these waves will be, then, about 62 ft. per second. The pressure per square foot of water moving at this speed would be $62.5 \times 62^2 \div 32 = 3.7$ *tons*, approximately.

This result seems absurd as compared with that just deduced for the pressure of waves in mid-ocean, but the absurdity is only apparent. Mr. STEVENSON has measured the pressure of waves by means of a marine dynamometer, a description of which may be read in the "Encyclopædia Britannica," under the article on "Harbors." In that article the results of these measurements are thus summarized:

> The greatest result obtained by the dynamometer at Skerryvore Lighthouse, in the Atlantic (12 miles out, in 36 ft. of water), was during the heavy westerly gale of March 29, 1845, when there was registered a force equivalent to 6,083 lbs. per sq. ft. The next highest was 5,323 lbs. In the German Ocean, the greatest result obtained at the Bell Rock was 3,013 lbs. But subsequent and much more extended observations at Dunbar, in the county of East Lothian, gave 3¼ (gross) tons; while at the harbor works of Buckie, on the coast of Banffshire, the highest result of observations, extending over a period of several years, was 3 tons per sq. ft.

Hence it will be seen that the assumption of a velocity of the particles of water equal to that of the waves, although not in accordance with theory, still leads to results agreeing with experiments.

Now, considering to what extent these facts should be regarded as having bearing on the case of a lighthouse in 24 ft. of water, it has been pretty well determined that waves must break in water whose depth falls below their average height. *Where* will they break? It is obvious that they are as likely to break just at the lighthouse as anywhere else, and that there is every reasonable probability, of their doing so if they are high enough to break outside in still deeper water at not infrequent intervals. We wholly fail to see by what reasoning the conclusion is justified that the only wave force to be provided for in the structure is that due to the static head of rollers, with or without the moderate dynamic effect of such rollers in the open sea, of some 200 to 300 lbs., which we have just determined; and this seems especially true inasmuch as it is proposed to build and maintain a mass of rip-rap around the structure up to low water line.

Therefore it would seem as if the following empirical rules for the maximum wave pressure against either a continuous or detached breakwater may be assumed as giving no greater margin of safety than reasonable prudence demands:

First; calculate or assume the height of the waves, either by means of the usual formula for maximum fetch when the breakwater is partly sheltered, or by assuming it as equal to the depth of the water as a maximum, beyond which point the waves are pretty certain to change into breakers.

Second; find the velocity of the wave as already xplained.

Third; find the pressure per square foot of a jet of water moving with this velocity.

Fourth; assume this to be applied at the crest of the wave and to decrease gradually downward.

Applying these rules to the particular case of the Diamond Shoals lighthouse and assuming a wave of 24 ft. from crest to trough, we would have for the maximum pressure due to the waves $62.5 \times (47)^2 \div 32 = 4{,}624$ lbs., 47 ft. per second being the velocity due to a fall of $12 + 18$ ft., $=$ ¼ depth of water + ¾ height of wave, as above determined.

This calculation, also, applies purely to the dynamic effect of the water in motion, because of its motion. It does not at all include the static effect of the head of water which is estimated above as 3,090 lbs. per sq. ft. as a maximum. Adding the two together we should obtain 7,714 lbs., which does not much if at all exceed that which has been actually observed at lighthouses similarly situated.

The dynamic effect, however, is greatest at the surface, and diminishes gradually downward, while the static effect is least at the surface and increases gradually downward. If we take the average of the two, 3,857 lbs., and consider it as the average pressure on the normal surface over the whole affected vertical area, we shall not err much, if at all, on the side of safety. It might, in fact, be plausibly urged that, although the maximum dynamic pressure only exists at the surface of the water, nevertheless, in the absence of experiments at various depths at all equal in accuracy to those of Mr. STEVENSON and his associates, it would be advisable to assume this amount as applied to the whole affected surface of the structure where this does not exceed 30 to 50 ft.

The correction for this wave pressure due to its being exerted on a cylindrical surface is still more difficult to determine, and at present the best assumption that can be made is to consider it as six-tenths of the pressure against a flat surface of the same length and having a width equal to the diameter of the cylinder. The assumption that it is only half as great applies only, as we understand it, to cases where the jet is free to deflect laterally, not when it is confined by water on each side Otherwise, it is somewhat too liberal, and the error is on the side of danger.

This correction for the cylindrical surface would reduce the average pressure on the whole projected surface to $3{,}857 \times 0.6 = 2{,}314$ lbs.

There remains the third correction of the static head above noted, due to the fact that the deflected wave does not tend to rise so high on the oblique surfaces. The correction is undoubtedly sound in

*"The *speed of the waves* depends principally on their length and on the depth of water, being greatest for long waves and deep water. When the depth of water is greater than the length of a wave the speed is not sensibly affected by the depth, and is almost exactly equal to the velocity acquired by a body in falling through *half of the radius of a circle whose circumference is the length of a wave.* In water that is very shallow, compared with length of the wave, the velocity is nearly independent of the length, and is nearly equal to that acquired by a heavy body in falling through *half the depth of the water added to three-fourths of the height of a wave.*—RANKINE'S Civ. Eng., p. 754.

principle; but on the other hand, it applies only to the static effect, and there is a contravening allowance to be made for possible *interference* of waves, two meeting together at a slightly different angle, or catching up with each other, because of different heights and speeds. The possibility, not to say probability, of this is undeniable, and it seems to us, therefore, that enough has been done in the way of correction when the allowance above has been made for the rotundity of the tower.

There remains, of the primary questions affecting stability, only that of the possible scouring out of the bottom, either from gradual natural change or as an effect of the obstruction of the tower, or of a possible wreck. We believe there is some evidence that this shoal has materially deepened in the past half century; it may continue to do so. The lighthouse may certainly aggravate this tendency locally. The precedents tending to show just what may happen are scanty and of dubious pertinency. It seems to us quite among the possibilities that a single great and long-continued storm might scour out the sand to a depth of 30 or 40 ft., and it, therefore, seems no more than a reasonable concession on the side of safety to require that the structure shall be safe against the above determined wave pressure on the affected area when the bottom is so scoured out that the water is twice as deep as now, or say 50 ft. deep.

For such a structure as this is a poor place, indeed, to take any chances with. It would be nothing less than a national disgrace if the structure should ever wash out; besides which humanity requires that the men exposed within it should have an ample factor of safety in their favor, which in this case is most truly a factor of ignorance, since wave strains are still for the most part an indeterminate quantity which cannot be precisely computed in advance. We have no idea whether the adopted plan is of such weight and strength as to be safe under the conditions outlined. Its general appearance would indicate that it is, but we have purposely avoided any attempt to determine whether it is or not by computation. If it is not now strong enough it should be made so; not that a much weaker structure *may* not stand, but because a structure which is any weaker *may* fail, and we apprehend, if much weaker, would be quite sure to fail.

CORRESPONDENCE.

Highway Bridge Failure—Correction.

ALBANY, N. Y., Aug. 30, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: In the account of the failure of a small highway bridge near Albany in your issue of current date, p. 194, you make me say that the structure broke down under a portable engine weighing, perhaps, 40,000 lbs. If you had chopped off a naught and made it 4,000, it would have been more like it. The engine was being drawn by two horses.

CHAS. F. STOWELL.

[The error, we find on inquiry, was duly corrected on the proof, but the total depravity of the printers prevented the proper correction being also made in the types.—ED. ENG. NEWS.]

The Sewerage of Houston.

HOUSTON, Aug. 26, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

In the article "Sewerage Systems in the United States and Canada," issue Aug. 23, you include Houston among the cities of more than 10,000 inhabitants which have no sewerage system. This is not correct, as there is a partly completed system here, and contracts, aggregating over $150,000, have been let to complete the system. Mr. KIERSTED, of Kansas City, is the Engineer of the work, and he has projected a thorough system, which will be rapidly finished.

Yours respectfully,

E. B. CUSHING.

[The information regarding Houston was given us by an official of the water company prior to the letting of the contracts referred to.—ED. ENG. NEWS.]

A Suggested New Form of Crank.

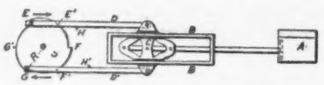
ESCANABA, Mich., Aug. 21, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: I am not sufficiently familiar with mechanical devices to know whether the enclosed sketch of a new form of crank is really new. It is new to me, and if some of the difficulties I see (and possibly some that I do not see) can be overcome, it looks to me as if it might be good for something. If it is old, perhaps you may be willing to tell me why it is not worth while to spend time on it.

The sketch enclosed has neither scale nor symmetry, but is drawn at random to illustrate the device.

A, is a steam cylinder, *B* is a fixed guide or traveling way for the crosshead *C*; *D* and *D'* are connecting rods pivoted to the crosshead, and they may engage with the crank wheel *S* in a variety of ways, the most easily explained being shown in the cut. The engagement is a loose one by a pin in the ends of the connecting rods. The action is made clear by the cut. There are three points, *E*, *F*, *G*, with which the pins successively engage. The points are one-third of a circumference apart, and the stroke is made one-sixth of it, or more correctly, the stroke is the chord of one-sixth of a circumference. Starting from the position shown, *E* is drawn to the right to *E'*. This stroke draws the pin in *D'* back "light" to *F'* where it meets and engages with *F*, and with the return stroke pushes the crank wheel to the left, while the pin in *D* goes "light" to its original position, where it meets and



engages with *G*, and so on, the power being applied alternately on opposite sides of the crank wheel, as shown by the arrows, and with substantially the full length of the lever arm *R*.

An alternative method of making the engagement would be by shoulders cut on the connecting rods engaging with pins fixed on the disk of the wheel. Another alternate method would be by pins on the rods, as in the cut, which should engage with shoulders cut in a circular slot on the disk of the wheel, the bottom of the slot being three inclined planes, each extending from the summit of one shoulder to the pit of the next. By using two of these wheels on the driving shaft, with the slotted disks facing each other and the shoulders cut in contrary directions, the motion can be reversed by disengaging the connecting rod pins from one wheel and throwing them over into engagement with the other. This could be done with a lever actuating cams attached to the rods at any convenient point, the office of which would be analagous to that of the link motion of a locomotive engine, except that the link motion reverses the steam valve, while in this the motion of the crank is reversed while that of the steam valve is not. With this motion, in fact, it would not be necessary to have any steam reverse gear. It may be that the objections to loose connections between the connecting rods and the crank may be too serious to overcome, so that the device is impracticable; yet the ordinary link motion is not more complicated than some device that would impart to the rods *D* and *D'* the movements that would effect the engagements with mechanical certainty.

I have divided the circumference into three points of engagement; mathematically it could be divided into any odd number, as 5, 7, etc., the stroke being shortened from 1-6 to 1-10, 1-14, etc., of a circumference, reducing the speed more rapidly. Even as shown, with six strokes required to complete one revolution, the motion is too slow to be available for locomotive or other quick engines, but for ordinary stationary engines that go only in one direction, or for marine engines, by using the reversing idea described, it looks like a possibility. But if the device or its equivalent is old and exploded, and you happen to be aware of it, please say as much. I have been told that something similar has been used in electric signaling, viz., a forked connecting rod, each leg of which was again divided, and straddled the opposite edges of the driving (crank) wheel, with which they were engaged and disengaged at any point by friction clutches attached to the legs; but, I do not find any electric signaling apparatus answering to this illustrated in the manual of the Union Switch & Signal Co.

C. PALMER, M. Am. Soc. C. E.

[The device is ingenious and workable, but not new in idea. See Crecy's "Encyclopedia of Civil Engineering," p. 972, for a device essentially similar, but with the further advantage of having no loose parts. We do not know why this device is not more used practically; it would seem to have some good points, but the inevitable lost motion is probably the reason. Still, for certain uses, such a movement is well suited, and we think our correspondent is correct in his suspicion that it is used in some forms of signaling apparatus.—ED. ENG. NEWS.]

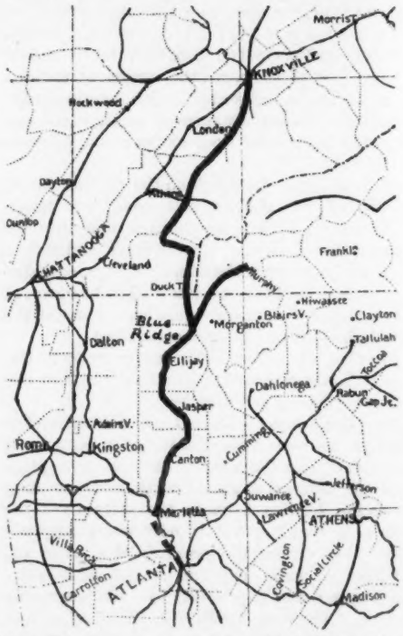
Notes and Queries.

E. F. T. asks: Has asphaltum, or any compound containing it, been used for facing rock-fill dams? Such construction has been proposed for a 110-ft. dam now under consideration. Is asphaltum or asphaltum concrete a suitable material for lining canals and water pipe?

[It has never been used for a rock-fill dam to our knowledge; there are but few such dams in existence. We see no reason why a proper coating of asphalt paving material should not be admirable for such a dam, or for making a spillway over it, the great and only difficulty with such dams, assuming them properly founded, being that water flowing over the top in large volume may cut it away as it does an earth dam, if proper provisions for spillway have not been made. Asphalt is largely used for coating water pipes, and should be excellent (if somewhat expensive) for canals.]

The Marietta & North Georgia Railway.

The completion of the Tennessee division of the Marietta & North Georgia Railway opens up one of the most important connecting lines recently constructed in the South. The Marietta & North Georgia R.R. Co., which now operates 240 miles



Map Showing Route of the Marietta & North Georgia Ry.

of railway, was organized as a local enterprise to build a short narrow guage line from Marietta, Ga., northeast, to open up mines in the vicinity. The first 24 miles were completed in 1879. Soon after this a new management assumed control of the road and extended it during 1883, 1884 and 1887 to Murphy, N. C., with a short branch from Tate, Ga., to mines, making a total length of 118 miles. In 1887 the original company and the North Carolina & Georgia R.R. Co., under which name the North Carolina division had been built, were consolidated under the present name. Early in the same year the city of Knoxville, Tenn., voted to aid any railway which would build to the city. The Marietta & North Georgia Railway Co., through the Knoxville Southern R.R. Co., submitted a proposition to build from its main line to Knoxville for a bonus of $275,000 in bonds. In August the bonds were voted, to be issued when the road was completed. Construction commenced shortly after, and has been pushed with vigor. The route is through a very rough mountainous section of the State, and in many places the work was very heavy. The greater portion of the grading was completed in 1889, and 14 miles of track were laid, the remainder of the road being completed in 1890.

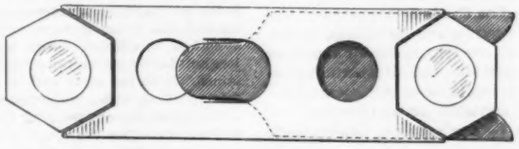
In connection with the work on the Knoxville Southern R. R., the gauge of the entire line of the Marietta & North Georgia Ry. has been changed from 3 ft. gauge to standard. This work, however, entailed but little additional grading, as all but the first 23 miles of the roadbed had been constructed for standard gauge track.

The route of the completed line is through a rich mineral section of the country, penetrating the heart of the marble region of northwest Georgia and the iron and copper mines of eastern Tennessee. At Knoxville connection is made with the Knoxville, Cumberland Gap & Louisville R. R., and a route to the Cumberland coal and iron fields is opened to Georgia and the South. On the completion of the 20-mile extension from the southern terminus to Atlanta, Ga., connection will be secured with the railways centering at that city. This extension has been located and will probably be built soon. At Murphy the road will connect with the Richmond & Danville extension, now nearly completed to that place.

The road has not been very profitable in the past, but now that it can compete for through traffic between the growing centers of Knoxville and Atlanta it seems likely to do very well; and with the development of the local mineral resources along the line it may become a very profitable property.

The "Positive" Nut Lock.

We illustrate herewith a new candidate for favor in the nut lock line which has some obvious merits and appears to have also some defects whose importance or the reverse it will require practical experience to determine. The new device is simple enough, consisting simply of two pieces of thin steel stamped into shape. Its operation will be readily seen from the drawing. The lock acts as a wrench to keep the nut from turning and is held from falling off by a tongue in a thin piece of spring steel which has one end held between one of the nuts and the fish plate.



THE "POSITIVE" NUT-LOCK FOR RAIL-JOINTS.

An opening in the lock permits the entrance of the tongue.

The most obvious defect of this lock is the fact that the nut must be turned to a particular point which may lack from 60° to 90° of a full turn for what is needed to bring it home. The makers claim that this is of no practical importance; but an extended practical trial would seem to be needed to determine this definitely. On some sections of road where trespassers are numerous the ease with which these locks can be removed might be an obstacle to their success.

As for its practical merits, the lock is positive, as its name implies, and it is durable, simple and cheap, and not as liable to be lost as some of the small washers on the market. The lock itself is stamped from soft sheet steel, No. 15 B. W. G. The spring tongue is open-hearth spring steel, No. 20 B. W. G. The weight is about 2½ oz. to each pair of nuts. Locks sufficient for a mile of double-track road with 4-bolt joints are furnished for about $14.

The first experimental locks of this style were applied to track in March, 1889, and have done good service ever since. About 5,000 of these locks are to be applied on the Zanesville (O.) Terminal Ry. The Positive Nut Lock Co., Jeffersonville, O., are the makers.

The Computation of River Discharges.

BY GEO. H. JOHNSON, S. D., U. S. Asst. Engr., Miss. River Comm.

For the purposes of this problem the flow of the stream may be considered to be steady and uniform. We will take the vertical plane of the discharge section, which is preferably normal to the river banks and current, as the plane of $x\,y$, the axis of x in the water surface, and y positive downward.

Then if $y = f(x)$ is the equation of the curve of the section, and $y' = f'(x)$ the equation expressing the mean velocity perpendicular to the section of each vertical filament whose abscissa is x, we have for the total discharge through the section, in a unit of time:

$$D = \int y y' \, dx \qquad (1)$$

But in any natural channel we know the river bed and the velocity curve only as two polygons whose vertices have been determined.

We will suppose that both polygons are made practically coincident with their curves by taking n soundings $s(1) \ldots . s(n)$, from water's edge to water's edge, with mean velocities $v(1) \ldots\ldots v(n)$ measured or interpolated for each of the stations. Let $x(1) \ldots x(n)$ be the abscissas of the velocity stations; then the equation of the river bed between any two consecutive stations, *e. g.* the mth and $(m+1)^{th}$ will be $y = a\,x + b$ and the equation of the velocity curve $y = a'\,x + b'$, where $a = \frac{s(m+1) - s(m)}{x(m+1) - x(m)}$ and $a' = \frac{v(m+1) - v(m)}{x(m+1) - x(m)}$

Hence $y\,y' = a\,a'\,x^2 + (a\,b' + a'\,b)\,x + b\,b'$, and equation (1) by substitution and integration becomes

$$D = \sum_{m=1}^{m=n-1} \left[a\,a' \frac{x^3}{3} + (a b' + a' b) \frac{x^2}{2} + b b' x \right]_m^{m+1} \qquad (2)$$

Otherwise we may proceed as follows: At any instant of time, t_0, a film or layer of water of infinitesimal thickness is crossing the discharge section.

After a short interval $\triangle\, t$ we shall have at the the time $t_0 + \triangle\, t = t_1$, each particle of the film in an advanced position. We will take the axis of z positive down-stream. Then the z ordinate of any particle at time t_1 will be the distance it has moved from the discharge section in the time $\triangle\, t$, and the corresponding velocity is $\frac{z}{\triangle\, t}$. The time interval $\triangle\, t$ is generally taken as one second.

The plane film of water which was crossing the section at time t_0 will generally be a double curved surface at time t_1—each point in the latter being the new position of a particle in the former. The volume of water bounded by the two positions of the film is evidently the discharge which we require. To find this volume precisely it would be necessary to have the equation of the double curved surface formed by the film in its second position. It is not practicable to obtain this equation, although for a rectangular channel of uniform section it is known that the surface approximates to a paraboloid whose axis is parallel to the water surface and in the median vertical plane.

In practice the velocity observations are made at each station in such a way as to give an approximate mean velocity for the vertical filament through the station. In this way the parabolic or double curved surface included between two planes or stations whose abscissas are p and q may be replaced by a plane whose equation is $z = a'x + b'$, where the constants a' and b' are determined by the observed velocities $v(p)$ and $v(q)$.

Thus, since the origin of co-ordinates may be so taken as to make $b = o$, we have simply to find the volume included between the six planes.

$y = o.$	$z = o.$	$x = p.$
$y = a\,x.$	$z = a'x + b'.$	$x = q.$

Hence, by a very simple triple integration, we obtain for the discharge between the stations considered $D = \left[\frac{a\,a'}{3} x^3 + \frac{a\,b'}{2} x^2 \right]_p^q \qquad (3)$

To simplify this expression we assume $\frac{v(p) + v(q)}{2}$ instead of $a'\,x + b'$ as the upper z limit. In this way we obtain the approximate formula

$$D = a \frac{v(p) + v(q)}{4} (q^2 - p^2) \qquad (a)$$

This gives the common rule of multiplying each partial area by its mean velocity.

As a closer approximation we may assume $v(p)$ as the z limit between p and $\frac{p+q}{2}$, and $v(q)$ as the limit between $\frac{p+q}{2}$ and q. In this way we obtain the equation

$$D = \frac{a\,v(p)}{2} \left\{ \left(\frac{p+q}{2} \right)^2 - p^2 \right\} + \frac{a\,v(q)}{2} \left\{ q^2 - \left(\frac{p+q}{2} \right)^2 \right\} \qquad (b)$$

This gives the second approximate rule, viz., form partial areas by locating ordinates midway between the velocity stations, then multiply each observed velocity by the partial area to which it belongs.

As an example of the application of these formulas and rules, suppose we have given in feet $q = 200$, $p = 150$, $s(q) = 40$, $s(p) = 30$, $v(q) = 5$, $v(p) = 4$; whence $a = \frac{1}{8}$, $a' = \frac{1}{50}$, $b' = 1$, and the exact equation (3) gives

$$D = \left[\frac{x^3}{5 \cdot 50 \cdot 3} + \frac{x^2}{5 \cdot 2} \right]_{150}^{200} = 7916.66$$

This result can be obtained immediately from the prismoidal formula, since the volume D is by supposition a hexaedron, seven of whose diedral angles are right angles; thus by the common rule we have for the example given

$$D = \tfrac{50}{6} (4 \cdot 30 + 4 \cdot 4\tfrac{1}{2} \cdot 35 + 5 \cdot 40) = 7916.6.$$

The approximate formulas (a) and (b) are more simple; thus we have from (a)

$$D = 50 \cdot 35 \cdot 4\tfrac{1}{2} = 7875, \text{ and } (b) \text{ gives}$$
$$D = 25\,(32\tfrac{1}{2} \cdot 4 + 37\tfrac{1}{2} \cdot 5) = 7937.5.$$

From geometrical considerations it is evident that the error of formula (a) will always be

$$E(a) = -\tfrac{1}{12} (q - p)\,(s(q) - s(p))\,(v(q) - v(p));$$

likewise the error of (b) will be

$$E(b) = \tfrac{1}{24} (q - p)\,(s(q) - s(p))\,(v(q) - v(p)).$$

Thus in the above example

$$E(a) = -41.66 \text{ and } E(b) = +20.83.$$

Several remarks may be made regarding these equations.

(1) The error of (a) is just twice the error of (b) and in the opposite direction.

(2) Each error vanishes when either of the factors $q - p$, $s(q) - s(p)$, or $v(q) - v(p)$ vanishes. But the latter two, within the limits of each partial area, are supposed proportional to $q - p$; hence the error of the computed discharge through any such area found by either approximate method varies as the *cube* of the distance between the observation stations.

(3) Wherever either factor $s(q) - s(p)$ or $v(q) - v(p)$ is not vanishing, and the other one is large, the prismoidal formula, or its equivalent, should be used; otherwise the errors of the approximate formulas may be reduced by interpolating both depth and velocity at one or more intermediate stations. Every half-way station thus interpolated divides the error arising from the inaccuracy of the formula by 4. This device is sometimes useful where the field work has been incomplete, or in the case of end partial areas where the depths and velocities greatly change from station to station.

(4) The errors are not cumulative, since each partial discharge is computed independently of the others; but they are all of the same sign except when $s(q) - s(p)$ and $v(q) - v(p)$ have opposite signs.

(5) Since the results obtained by the two methods have errors of contrary sign, it is well sometimes to use (a) for one-third of the section and (b) for the remaining two-thirds.

Formula (a), corrected where necessary by $E(a)$, gives the best general method; it is much more expeditious than the direct use of the prismoidal formula.

Legal Decisions of Interest to Engineers.

Modification of a Contract Virtually Makes a New Contract.—The plaintiffs entered into a contract to grade a railroad for defendant, according to plans and specifications as furnished prior to the making of the contract. During the progress of the work the defendant modified the plans, by omitting all trestle work and making a continuous embankment, which necessitated the construction of a continuous ditch not contemplated in the original plans. This ditch made it necessary to haul the earth from high ground where the embankment was low to low ground where the embankment was high, whereas but for the ditch the earth for the embankment would have been obtained directly from the sides; this in many cases necessitated the longer haul of earth, and increased the cost of the embankment. These changes in the work created a feature enough different from that originally contracted for to make as to that feature a new contract. The engineer of the defendant was authorized to have the change carried out and to make a new contract for the ditching. It was not an improper contract for the engineer to agree that plaintiff should be paid for the whole valume of the ditch throughout its entire length, whether or not such volume coincided with the spaces which would have resulted if no drain had been dug. (Henderson Bridge Co. v. McGrath, Supreme Court of the United States, 10 Sup. Ct. Rep., 730.)

Tests of the Baldwin Compound Locomotive.

In ENGINEERING NEWS of May 3, 1890, a full description and illustrations were given of the new compound locomotive designed and built by the Baldwin Locomotive Works, for the Baltimore & Ohio R. R. At the time it was stated that careful tests of the economy of the engine were in progress. The results of these tests, which were made by Mr. GEO. H. BARRUS, of Boston, have just been made public in a neat pamphlet issued by the Baldwin Locomotive Works. The substance of the showing made is a very satisfactory one.

To determine the relative value of the simple and compound locomotive a series of tests were made on a simple locomotive of the exact pattern of the compound with the exception of the cylinders and valves. The locomotives tested are 8-wheel passenger engines with 66-in. drivers, and weigh about 105,000 lbs. They have 58-in. wagon top boilers with brick arch in fire box, extended front ends, and double exhaust nozzles.

The general dimensions of the two engines are shown in the following table:

Total weight in running order	105,460 lbs.
Weight on drivers:	
Compound	71,515 "
Standard	72,460 "
Weight of tender, light:	
Compound	29,800 "
Standard	29,250 "
Diameter of barrel of boiler	58 ins.
Tubes (251 2 in.), length	11 ft. 10 ins.
Grate	107.7 × 33.9 ins.
Depth of fire box:	
Front	63.2 ins.
Back	48.2 "
Diameter of smokestack	18 ins.
Area of cross-section of tubes	4.2 sq. ft.
Area of heating surface	1,504 sq. ft.
Area of grate surface	25.2 "
Ratio of heating surface to grate surface	59.7 to 1
Diameter of drivers	66 ins.

The following table gives the dimensions of the cylinders, valve gear, etc., of the two engines. It will be recalled that the compound is of the four-cylinder type:

	Compound. H.-P. Cyl.	Compound. L.-P. Cyl.	Standard.
Diameter of cylinders (ins.)	12 right. 12 3-16 left.	20	19
Diameter of piston rod (ins.)	3¼	3¼	3
Stroke (ins.)	24	24	24
Outside lap of valve (ins.)	⅞	⅝	¾
Inside lap of valve (ins.)	⅛ negative.	0	⅛ negative.
Lead (ins.)	0	1/16	1-32
Valve travel in full gear (ins.)	5½	5½	5½
Width of ports (ins.)	1⅜	1⅜	1⅝
Length of ports (ins.)	Total 19	Total 19	16
Clearance (p. c.)	12	8	9
HP. constant for 1 lb, M. E. P., 1 rev. per min.	.01321 right. .01364 left.	.03758 both.	.0339

The compound locomotive was fully described in our issue of May 3. It was designed by S. M. VAUCLAIN, Superintendent of the Baldwin Locomotive Works. The cylinders of the standard engine were arranged in the usual manner, and its slide valves were balanced.

GENERAL PLAN OF THE TESTS.

These two locomotives were first tested in fast passenger train service on the Baltimore & Ohio R. R. between Philadelphia and Washington, a distance of 133 miles. The train was a "limited express," scheduled to make the run at the rate of 48 miles per hour, including four stops, two points where speed is slackened and the slow runs through the yards at Philadelphia, Canton, Washington and Baltimore. These necessitated the closing of the throttle for about 15 minutes out of the 2¾ hours scheduled for the trip.

Grades of 42 ft. per mile are quite numerous on the Philadelphia division, and there are two still steeper grades of 76 ft. and 55 ft. per mile. There is one 11° 30′ curve and one of 7°. The Washington division is fairly level, and the sharpest curve (immediately at the terminal) is 10° 30′. The line otherwise is almost free from curves.

The train handled was composed of 4 cars between Philadelphia and Canton and 3 cars between Canton and Washington. The 3 cars which made the round trip were vestibuled and were a combination car, coach and Pullman parlor car. The car dropped off or taken on at Canton was an ordinary passenger coach.

These tests were made between April 30 and May 9. On the first four days the compound engine made the round trip daily, and on the second four days the standard engine made the round trip each day.

A second series of tests was made a month later on the compound locomotive alone, which was run between Philadelphia and Baltimore, taking on its down trip an accommodation train making 65 stops, and on its return trip to Philadelphia an express train making 4 stops and slowing up at the same points as the train run in the first series of tests. Three round trips were made in this series of tests. The accommodation train consisted of a combination mail and baggage car and two passenger coaches. The express train was composed of 5 cars —baggage, smoker, day coach and two Pullmans.

The engines were handled in about the usual manner. On the compound, the by-pass valve, which connects the two ends of the high-pressure cylinder and thus admits steam from the boiler into the low-pressure cylinder, was opened for the first two or three revolutions when the engine was started. The throttle valve was much of the time carried wide-open, especially on the compound engine. Steam is used for the blower, to sound the whistle, drive the Westinghouse air brake pump, and heat the train, when required. For the last purpose a small amount of steam was used on April 30 and May 8.

In firing, the coal used is sprinkled before firing enough to lay the dust, the water being taken from the boiler. The coal is thrown on the back end of the grate, and the pull of the draught is relied on to spread it over the grate. The stoking bar is used when needed, and when the steam pressure rises too high the fire box door is opened.

The data determined on the tests consisted of the weight of the coal used for the entire trip, as also for various periods of the trip, indicator diagrams from each end of the cylinder, and all other information bearing on the performance of the locomotive.

COAL USED AND METHODS OF MEASURING.

The coal used was George's Creek, Cumberland, bituminous, from Piedmont, W. Va. In order to secure uniformity a sufficient quantity was put aside in the beginning to furnish the supply through out the whole series. Unfortunately, however, it was exposed to the weather and a correction had to be made for the amount of moisture contained. Moreover there was considerable variation in the quality of the coal at the three points where it was taken on. The heating value of the coal used in the first series of tests, measured with a Thompson colorimeter, was 12,744 H. U. for the Philadelphia coal, 13,614 H. U. for the Washington coal, and 13,825 H. U. for the Baltimore coal.

The measurements of the coal used for each day's test embraced that required for the whole 24 hours, including getting up steam and banking the fire at night.

On the second series of tests the coal was put under cover and kept dry. The amount used in the accommodation run down and the express runs back were measured separately.

The accompanying table gives the main results of the tests, and we conclude by giving, in advance of completing the full report, for which we cannot find room this week, the following summary or review of the tests, giving their apparent net results:

The principal facts brought out by the tests, and the important conclusions drawn therefrom, may be briefly summarized as follows:

1. The average consumption of coal for four round trips between Philadelphia and Washington, was 14.9 per cent. less in the compound engine than in the standard engine; and the consumption of steam per HP. per hour during the selected periods of the runs which have been analyzed, was 5. per cent. less in the compound engine than in the standard. The increased saving of coal over that of steam appears to be due to the improved action of the exhaust blast upon the fire, which the compound principle secures. These results were obtained under the severe conditions of service required in moving an express train at a rate of speed varying from 50 to 60 miles per hour.

2. The compound engine is more economical in the use of steam when running at slow speeds than at high speeds. The steam consumed when running at a speed of 257 revs. per minute (50.4 miles per hour) was 25.69 lbs. per I. HP. per hour, while that at a speed of 176 revs. per minute (34.5 miles per hour) was 20.86 lbs. per I. HP. per hour. The difference between these quantities is 19 per cent.

3. The increase in the consumption of steam which accompanies an increase of speed in the compound engine is due to loss produced by the greater frictional resistance which the steam encounters in passing through the various ports leading to and from the cylinders. This loss appears to be more serious in the compound engine, with its double system of cylinders, than in the standard engine, with its single cylinder; and the conclusion may at once be drawn that the compound engine, in its present shape, will secure a greater saving of fuel when used on heavy express trains running at medium speed, on accommodation trains, and on freight trains than when used on fast express trains. The tests furnish ample reason to expect a saving of coal on freight trains, and on accommodation passenger trains making frequent stops, of not less than 30 per cent.

4. In the construction of future engines, improvements in the form, size, or arrangement of the passages which conduct the steam from one cylinder to the other may doubtless be effected, which will reduce the frictional loss noted and increase the economy beyond that now obtained. With the same end in view, the use of a larger driving-wheel, with a proportionate increase in the stroke of the piston, thereby reducing the number of revolutions without changing the speed of the train, would be advantageous. Still another improvement may be made by reducing the size of the high-pressure cylinder to 11 ins., and carrying a longer cut-off, the boiler pressure being increased at the same time, if found necessary, to 180 lbs. By this means a wider port opening may be obtained without reducing the degree of expansion.

5. In conclusion, the performance of the compound engine, as to running features, compares favorably with the locomotive of the older type. It steams freely, and without undue exertion on the part of the fireman. It starts from a state of rest quite as promptly as the standard engine. No difficulty is encountered in moving the fastest trains with the engine on schedule time, and, when required to do so, in making up a reasonable amount of lost time. Its ability to make time is well shown by the fact that, during the tests, the terminal stations at Washington and Philadelphia were reached, on four successive days, either on time or a little ahead of time, without a single exception, although the train was frequently delayed at stopping places. The effect of the reciprocating parts, although weighing more than those of the simple engine, appeared to be inappreciable. The jar produced by these and other disturbances, so far as it could be measured by the feelings of a person riding either in the cab or on the pilot, was no greater in one engine than in the other.

Altogether, judging from the manner in which the new engine operated during the progress of the tests, it meets all the mechanical requirements demanded by a successful locomotive.

AVERAGE RESULTS PERTAINING TO COAL AND WATER MEASUREMENTS FOR FULL TRIPS.

Name and number of engine	Compound, No. 848.	Standard, No. 840.	Compound, No. 848.	
Number of runs averaged	4.	4.	3.	
Route and distance covered by test	Philadelphia to Washington and return, 266 miles.		Philadelphia to Baltimore, 96 miles.	Baltimore to Philadelphia, 96 m les.
Schedule time of trip	6 hours.		3 h. 55 min.	2 h. 35 min.
Class of train	Washington limited express.		Accommodation.	Express.
Number of cars hauled	4 between Philadelphia and Canton. 3 between Canton and Washington.		Three.	Five.
Approx. wt. of train, including engine	210.5 tons.*		149 tons.	237 tons May 27 and June 2; 254 tons May 28.
Car miles traveled	979		288	490
Ave. consumption of coal (dry), lbs.	13,942.	16,389.	4,793	5,591.
Ave. percentage of ashes, %	5.1	3.8	6.9	4.5
Total weight of water for the trip, lbs	84,506.	88,040.	35,340.	33,356.
Temperature of water in tank	60°	59°	64°	68°
Weight of water evaporated per lb. of coal, lbs.	6.06	5.37	7.38	5.96
Equivalent evaporation from and at 212° per lb. of combustible, lbs.	7.69	6.7	9.56	7.49
Coal consumed per car mile, lbs.	14.2	16.7	16.6	11.4

* This is the weight of the train running between Philadelphia and Canton; the weight between Canton and Washington is 186.5 tons. The weight on the down trips of May 6 and 7 from Philadelphia to Canton was 9.5 tons less than the quantity given.

Railroading In Yucatan.

For the following interesting particulars of railway progress in the Mexican province of Yucatan we are indebted to Mr. W. IRVING WILLIS, who has just returned from that country, where he has been engaged for some time on the Merida, Progreso & Sotuta Ry.

The rapid progress which this little-known province has made in railway building may be seen by the fact that whereas in 1881 there was only one line of railway in the country, and that only 10 miles long, there are now four large railways with an aggregate extent of over 450 miles.

The only one of standard gauge is the Merida, Progreso & Sotuta Ry., which now extends from Progreso via Merida to Izamal, about 100 kilometers. Of this the portion from Merida to Izamal has just been completed and opened for traffic. Another extension of about 70 miles is contemplated, and work is to begin in about two months. ANATALIO G. CANO, Merida, Yucatan, is General Superintendent.

The Merida & Valladolid Ry. Co. has just completed arrangements to obtain about $1,000,000 of English capital to build a large extension to their road. This line is practically owned by Gen. FRANCISO CANTON, of Merida.

The Merida & Peto Ry. is about 75 kilometres long, and negotiations are now in progress to secure funds for an important extension to Tecash. OLEGARIO G. CANTON, of Merida, is Chief Engineer.

The Merida, Calkini & Campeachy road is now under construction from Merida to Campeche, 164 kilometres. Of this about 100 kilometres are completed, part on each end, and the construction forces are working toward each other.

On all these lines the work of every sort is being done almost wholly by native capital and native labor and directed by native officials and engineers. As all the lines are carrying a heavy traffic and paying handsome dividends, Yucatan can already boast of railway kings of very considerable wealth. The principal traffic is hemp, the raising of which is the chief industry of the country; but near the cities there is a heavy passenger traffic.

A great deal of rock work is required in construction but drilling is still done by hand, as with the native workmen and the lack of repair shops machinery is difficult to keep in order. Construction work is apt to proceed very slowly owing to the "piece work" method employed. Each native workman is given a strip of the line for his task, and allowed to take as long as he likes to finish it by the use of as crude methods as he pleases to employ. As the climate is very dry, ties last very well. Pine ties from Louisiana are principally used, which last about six years. One road has begun experimenting with metal ties and has two or three kilometres laid with alternate wood and metal ties, the latter being imported from England.

The rolling stock is all of American make, the locomotives being built by the Baldwin and Rogers works. The engines sent out have been first class machines, but with the hard water and the lack of skilled mechanics to run and care for them, they have rapidly deteriorated.

Besides the railways above mentioned, an enormous business has grown up in light portable railways for local traffic or street traffic, or plantation use. There are 200 to 300 miles of these light portable railways in use, the track for which was all made at the Decauville works in France. The rolling stock, however, has been made in Yucatan, with the exception of the first-class passenger cars, which come mostly from John Stephenson, of New York City. The Decauville track is very light, weighing complete about 20 lbs. per yd., including the two rails and the tie pieces. All the Decauville roads use animal traction.

Besides these railways there are a few narrow-gauge railways near the cities which have a somewhat heavier rail and use dummy engines.

Perhaps the most novel feature of railway engineering in this queer country is that there is not a single bridge—large or small—on any railway in all Yucatan, for the simple reason that there are no streams to bridge. The country is one vast lava bed, fissured and broken in every direction. Rain is quickly absorbed and flows downward to subterranean channels by which it finally reaches the sea; thus all the rivers and brooks of Yucatan are underground. The problem of drainage, so difficult elsewhere, is one which, in Yucatan, requires no attention. No ditches are dug, either in cuts or fills. In making embankments the practice is to build a dry wall of stone on each side and fill in between with whatever material can be easiest procured. When it is built up to subgrade, the ballast, of any fine material which happens to be handiest, is put on top. Thus with neither water nor frost to contend against, the lot of the Yucatan railway engineer is indeed a happy one.

The Steam Ice Breakers on the River Vistula.

The navigation of the lower part of the Vistula River, according to *Glaser's Annalen*, is extremely difficult in the spring on account of the large amount of ice in the water. Similar difficulties were experienced at Hamburg, but were overcome by building steamers of peculiar construction and considerable depth, about 14 ft., which, driven against the ice while it was forming, plowed it up into cakes that were swept away by the currents. At the mouth of the Vistula the depth of water was not sufficient to allow of such steamers being used—in fact, a draught of more than 5 ft. could not be permitted. The fishermen of Danzig were accustomed to break up the ice by dragging heavy scows against the ice-floes, as many as 300 men being employed to haul on the tow ropes. The scows were 68 ft. long, 8½ ft. wide, 3¾ ft. deep, and weighed 33.4 tons each. This plan, however, was so slow and costly that some other means of doing the work became imperatively necessary.

It was finally decided to construct a steam ice breaker, and Herr F. DEVRIENT, Director of the Danzig Ship Yards Co., was engaged to design such a vessel, the governing principle of the design being to run the bow up above the water so as to break down the ice by weight. Its principal dimensions are: Length over all, 82 ft.; beam, 15.6 ft. The compound engines are of 120 indicated HP.; the cylinders are 11.81 and 20.87 ins. in diameter and of 11.81 ins. stroke. The boiler has 58 sq. ft. of heating surface at 90 lbs. pressure; weight of hull, 57½ tons; weight of engines and machinery, 4½ tons; weight of boiler with water, 12¾ tons; coal, 6½ tons; load, 4¼ tons; total displacement, 85¾ tons. The screws have 4 soft steel blades of 8.5 ft. pitch and 4.6 ft. diameter, which have remained intact after 10 years of service.

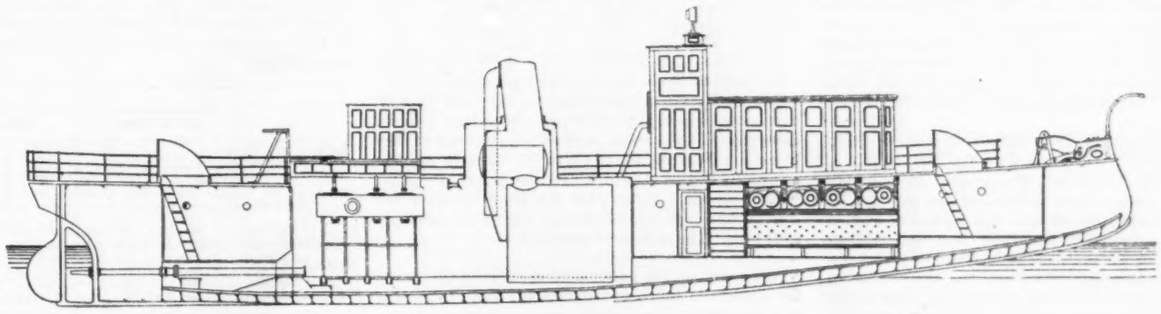
The steamer was first used in February, 1881. On its trial trip it broke up a flow nearly 2 ft. thick. This was done by running the ship half its length on the ice, which broke away on all sides from the weight thus brought upon it. The launch then moved back and rushed forward again on the flow. In this way the ice field was soon battered to pieces. The framing of the bow was naturally extremely strong, and the whole of the fore body was built of 0.51-in. plates of Siemens-Martin steel.

Three keels of hammered cast steel were fastened to the bottom and carried aft as far as the engine room. Two heavy braces were also fastened inside the framing at the water line.

This steamer was so satisfactory that a larger vessel of the same type was ordered the following fall. This steamer, the *Montan*, is 98.4 ft. long, 18 ft. wide and 8.9 ft. deep, with a draught of 5.25 ft. The cylinders are 14.17 and 26.77 ins. in diameter, respectively, with a stroke of 15.75 ins. The indicated horse power is 189. The boiler has 877 sq. ft. of heating surface with 90 lbs. pressure. Since the winter days were much too short for keeping the ice out of the harbors, arc lamps were mounted so that the work could be continued all night if necessary.

In 1884 a third steam ice-breaker was built and also a steam tender, the *Ferse*, which is employed in carrying coal and other supplies to the breakers. The lines of the fore body of this vessel were so modeled that it might act as a ram, the harbor in which the transport plies being filled with floating ice which must be rammed aside.

The dimensions of the *Ferse* and its machinery are as follows: Length, 98.5 ft.; 15.5 ft. wide and 7.9 ft. deep, with a draught of 5.25 ft. The total displacement is 100 tons. The compound engine has cylinders of 12.6 and 21.65 ins. diameter, respectively, with a 14.17-in. stroke, giving 150 indicated HP. The boiler has 560 sq. ft. of heating surface with 97 lbs. pressure.



THE ICE-BREAKING STEAMER "NOGAT." F. DEVRIENT, DESIGNER.

(Scale about $\frac{7}{1000}$).

In 1888 it was decided to build still another vessel for ice breaking, the *Nogat*, the contract was given to Herr DEVRIENT, who built the steamer shown in the accompanying cut. The lines of the fore-body of the *Nogat* were modeled about half way between those of the first vessel and of the *Ferse*, while in the after-body it differs but little from the first breaker. The stem is reflexed above the water line and forms a ram for breaking large masses of ice. The hull is built entirely of Siemens-Martin steel, 0.51 in. thick. The total displacement is 118 tons with a full load. The engine is of the triple expansion type usually furnished to torpedo boats; it has cylinders of 15.36, 22.84, and 33.07 ins. diameter, respectively, with 15.75 ins. stroke, giving a 250 indicated HP. The boilers have 878 sq. ft. of heating surface at 145 lbs. pressure. The speed is 10 knots an hour.

There were three keels on the *Weichsel*, but in practice it was found that ice clogged between them, and seriously impeded the management. On the *Montan* these keels were entirely omitted, but the steering was somewhat difficult on this account. Consequently, on the subsequent vessels, a single keel was used as in the regular construction of steam launches.

Many of the ferry boats and other steamers of the St. Lawrence River use this same principle of running the bow up on the ice to keep the channel open, and with much success.

The World's Ship-Building Industry.

The recently published Lloyd's Register of British and foreign shipping gives the following table of the ship-building of the world for the past two years, vessels below 100 tons register being omitted:

	1888.		1889.	
	No. of vessels.	Ton'ge.	No. of vessels.	Ton'ge.
United Kingdom	484	776,993	656	1,180,346
Germany	37	39,994	79	101,984
United States	73	38,198	115	84,832
France	14	10,721	22	42,921
British Colonies	68	17,106	75	27,568
Denmark	5	5,721	20	15,026
Norway	19	11,433	32	14,640
Netherlands	3	5,156	10	11,633
Italy	8	1,798	21	7,762
Sweden	15	4,088	25	7,084
Greece	15	3,086	17	4,319
Austria	5	5,038	9	1,853
Russia	7	1,713	7	1,830
Other countries	12	5,478	5	1,531
	765	926,523	1,090	1,502,629

It will be seen that the total output during last year increased by 325 vessels and 576,106 tons, of which Great Britain showed 172 vessels and 403,333 tons, or about 70 per cent. Other countries, however, even the United States, showed a larger proportionate increase, which may mean much or little. Whereas Great Britain built 84 per cent. of the 1888 tonnage, it only built 78½ per cent. of that of 1889. But Great Britain is still tending to increase the disproportion in her favor, she having much less than half the total tonnage of the world, for at the end of 1888 (ENG. NEWS, Sept. 14, 1889) the total of s ea-going tonnage for all countries was:

United Kingdom (ex colonies)	9,425,183
United States	1,918,175
The World	21,048,704

The total tonnage built in 1889 was only 3,673 tons ess than the combined outputs of the two preceding years, 1887 and 1888. The shipbuilders of the United Kingdom absorbed the lion's share in the revival, with an increase in their output of 403,353 tons, or 51.9 per cent. But the total increase in the world is 62.1 per cent., it is apparent that other countries have proportionately shared more largely in the increase.

Industries takes a more serious view of the slight revival in this country than we do, and thinks it possible that "American Competition in Shipping and Shipbuilding" may become serious shortly. It notes that even 20 years ago, in 1870, 40 per cent. of our entrances were in American bottoms, whereas now only 23½ per cent. are American. It prints the following mortifying table, and has the candor to admit what we have never before seen admitted in an English publication, that: "Up to 1860 the two countries had a real struggle for shipping supremacy, *which culminated in a substantial victory for the United States* in that year." To be sure, the figures alone show this, which are as follows:

	United Kingdom.	United States.		
	(Colonies not included.) Tons.	Oversea trade. Tons.	Home trade. Tons.	Total tons.
1840	2,724,000	899,000	1,241,000	2,140,000
1850	3,501,000	1,585,000	1,899,000	3,484,000
1860	4,586,000	2,546,000	2,753,000	5,299,000
1870	5,619,000	1,516,000	2,677,000	4,193,000
1880	6,519,000	1,352,000	2,715,000	4,069,000
1889	7,724,000	1,021,000	3,286,000	4,306,000

We have divided by a line the 20 years of advance from the 30 years of decline. It will be seen that the advance was something phenomenal, as has been our recent advance in iron production, and carried us well past England in 1860, for we then not only had a much larger home trade than hers (much of our home trade being of substantially the same nature as her European foreign trade), but had about an equal tonnage engaged in foreign trade, and that tonnage, it may be added, averaged faster and of a better quality than the British tonnage.

As it is now, our commercial marine is not so hopelessly inferior that we might not expect to very speedily recover our relative position if the energies of the nation were once to be turned that way. Our coastwise and other home commerce being enormous, we have still 56 per cent. of the British tonnage to start with, and probably fully that percentage of mariners. Moreover, as we showed in our issue of Jan. 26, 1889, our rapid growth to the largest merchant navy in the world, between 1840 and 1860, was in a period when our population was only 17 to 31 per cent. and our wealth only 4 to 19 per cent. that of Great Britain. Our population is now over 150 per cent., and our wealth fully 120 per cent. that of Great Britain, and therefore our rise to maritime equality with her ought to be correspondingly more rapid than it was before the war, if we once get turned that way.

The Measurement of Brickwork.

It is curious to observe how considerably the method of measuring brickwork varies in different parts of the country. In many localities, Philadelphia for example, the custom is to measure it by the number of bricks contained, but this system possesses a serious disadvantage. There is no uniformity in the size of bricks, and hence the size of a wall which a given number of bricks will produce is uncertain. When, therefore, the price per 1,000 for laying brick is given, considerable trouble is involved in arriving at the cost for the whole of the brickwork in the building.

Probably the better plan is to measure by the dimensions, as is common in several sections of the country.

The unit of measurement in this case is not important. The cubic foot or yard is employed to some extent, but the perch of 25 cu. ft. and the superficial rod in brickwork one brick thick are often used. Unfortunately, the term "rod" has no very definite significance. One and a half bricks thick, covering an area of 272½ sq. ft., and one brick thick, laid on an area of 16½ sq. ft., or 63 sq. ft., are all termed "rods." [The English "rod" of brickwork is 306 cu. ft.—ED.] Under these circumstances it would probably be of advantage if the cubic foot or yard could be made the standard unit of measurement for brickwork throughout the country.

It may be added that the number of bricks contained in any piece of built brickwork may be approximately ascertained by deducting one-tenth for the volume of mortar.—*A. S. J. in The Clay-Worker.*

THE WORLD'S TIN OUTPUT is divided approximately as follows; according to figures given in *Engineering:*

Tons of 2,240 lbs.	Pig tin.	Tin in tin plates.	Total.
United States	16,000	14,700	30,700
Europe	8,000	5,000	13,000
Other countries	6,000	2,800	8,800
Total	30,000	22,500	52,500

The tons of tin in tin plates are assumed to be divided in the same proportion as the total tons of tin plates, which are 562,500, of which the United States uses 65.6 per cent., against 53½ per cent. of the block tin. That the use of tin in this country should so greatly exceed that of all Europe is very surprising. The exact figures for the tin-plate used in Europe were not given, but only for Great Britain, 2,677 tons. The rest was estimated.

THE PRICE OF TIN has risen but little in the past 150 years from an average of $500 per ton. In 1888 it was about $580. The highest price ever known was in 1823, $920 per ton, and the lowest in 1843, $300 per ton. For the past 12 years it has tended slowly upward. England produces about 17 per cent. of the world's pig tin, Australia about 11 per cent., South America and Europe about 22 per cent., and the islands of the Malay archipelago the remaining 50 per cent. The limit for paying ore in Cornwall is regarded as 1½ per cent. Some California ores (San Bernardino Co.) assay 20 per cent. as an average of many samples; but no large output is yet coming from there.

THE MAINTENANCE OF PAVEMENTS IN LIVERPOOL is made a comparatively easy matter on account of the strict laws regarding its removal by private companies. According to a consular report, permission is never given to private companies or individuals to cut through the pavement in any street for any purpose. When such work is necessary the corporation will do it in its own thorough way, and the interested parties must pay the entire cost. All street railway tracks are laid, owned and maintained by the corporation, from which the companies lease them at an annual rental of 10% on their cost.

AT THE INTERNATIONAL ELECTRICAL EXHIBITION in Frankfurt next year, SIEMENS & HALSKE, the famous German electricians, will have an extremely interesting and instructive exhibit. In addition to a large arc and incandescent light plant, and the usual display of motors and telegraphic instruments, they will have a new storage battery tramway, and also one of the overhead trolley plan, an electrical mining car, a plant for generating ozone, and a model of their new apparatus for refining copper.

A RIVER IMPROVEMENT SCHEME IS PROPOSED at Jacksonville, Fla. It is estimated that for $500,000 the St. John's River can be deepened so that vessels drawing 20 ft. of water can come up to the Jacksonville wharves. It is proposed to bond Duval County to raise this sum. Another enterprise under consideration at this place is a terminal railroad for distributing freight.

THE WESTINGHOUSE PATENT ON A PIPE JOINT for natural gas mains was annulled by a court decision on Aug. 28. The invention consisted in inclosing the high pressure main within a tight protecting casing of larger diameter which collected the leakage. It was shown that the patent on which the suit was brought, which was issued to one VERNER, was anticipated by prior patents.

A MONSTER TRAVELING CRANE has just been erected in the gun shop of the Washington Navy Yard. It has a lifting capacity of 110 tons and weighs 185 tons.

THE SLAVEN DREDGING PLANT, purchased by the Nicaragua Canal Construction Co., includes 7 dredges of the most powerful type, 15 lighters, several tug boats, and the machine shops complete to keep this plant in order. Part of the plant is already on its way to Greytown, and the rest is being put in order for removal. The purchase price is understood to have been over a million of dollars, which is a heavy discount on its original cost. Three of the dredges averaged 150,000 cu. metres (about 195,000 cu. yds.) per month, and one of them excavated in one month 257,000 cu. metres or over 334,000 cu. yds. The plant will be used for completing the opening of the harbor, and excavating the first 10 miles of the canal.

THE RESULTS OF JUMPING, or drilling by means of a hammer and short drill, can be approximately calculated by means of the following table, taken from Prof. DOLEZALEK'S work on tunnels, noticed in another column:

Kind of rock.	Direction of hole.	Depth of hole per minute with		Cu. ins. bored per minute.	
		1 man and 1 in. drill.	2 men and 1.25 in. drill.	1 man.	2 men.
		Ins.	Ins.		
Very hard.	Falling	.16—.31	.14—.30	.12—.24	.18—.37
	Rising	.08—.23	.09—.20	.06—.18	.12—.24
Hard	Falling	.32—.59	.3 —.41	.24—.43	.37—.61
	Rising	.24—.29	.2 —.35	.18—.31	.24—.43
Soft	Falling	.59—.79	.41—.73	.43— 61	.61—.92
	Rising	.39—.59	.35—.41	.31—.43	.43—.61

THE "HIRSH" ALUMINUM PROCESS, which is being engineered by one "Prof." HIRSH, of the windy city of Chicago, seems pretty well proved to be a first class fraud. The newspapers and the trade journals have been giving wide circulation to the "professor's" statement that he could make aluminum from Chicago clay at a cost of 15 cents per lb. *The Engineering and Mining Journal* publishes accounts of a visit to the "professor's" office, where a small sample of the product of his "process" was obtained, which was claimed by HIRSH to be 99.9% pure aluminum. Analysis of this sample showed that it contained 98.53% aluminum, corresponding very closely to the composition of the Pittsburg Reduction Co.'s metal. Although the professor claims to be able to make aluminum from clay at a cost of 15 cents per lb., he declares that at present it will only be sold in the shape of manufactured articles. The scheme seems to be to secretly purchase the aluminum and make it up for sale, thus keeping up enough semblance of a genuine business to draw in a host of confiding investors. The popular interest in aluminum is so great at the present time that the field for the perpetration of frauds is very inviting. Those who are tempted to invest will do well to recall the "Schmiedbarenguss" scheme in Louisville, Ky., and the electric sugar refining process, which victimized some gullible New Yorkers not long ago.

IMMIGRATION for the first 7 months of 1890 shows 298,534 against 209,145 for the corresponding months of 1889, when immigration was very heavy. A change of the most serious and ominous character has been for some time going on in a large increase of emigration from Bohemia, Hungary, Italy and Poland, which for the period above-named was 69,700 against 29,234 for the corresponding months of 1889;

our least desirable immigration showing a tendency to increase, while the most desirable is falling off. Fortunately, however, the objectionable elements are still but a small fraction of the whole.

A NOVEL WIRE FENCE has recently been put on the market by a firm at Adrian, Mich. It is a rectangular mesh netting, with 10 horizontal wires and vertical wires at intervals of 12 ins. The most important feature of the fence is the horizontal wires, which are bent into a spiral of very steep pitch and small diameter. The vertical wires are wrapped about the horizontal at every junction in such a manner that any movement of them from their proper place is almost impossible. The horizontal wires are unequally spaced, being within 3 ins. of each other at the bottom and 12 ins. apart at the top. The spiral formation of the horizontal wires makes the fence remarkably stiff and strong. For a fence against small stock it is, of course, especially adapted. As put on the market it is made in a web 58 ins. wide, ready for fastening to the posts, put up in rolls of 20 rods or more. It weighs 10 lbs. to the rod, and is retailed at 75 cents per rod. On large orders for railway fencing it could doubtless be secured for much less. About 1,000 miles are now in use.

CONSTRUCTION NEWS.

RAILWAYS.

EAST OF CHICAGO.—Existing Roads.

Lehigh Valley.—This company is making arrangements for the construction of a branch from its main line at Pine Hollow, N. J., via Finesville, Hughesville and other places along the Musconetcong River to Riegelsville, N. J.

New York, Susquehanna & Western.—This company proposes to issue $3,000,000 of bonds. The bonds are secured by a mortgage given to the Central Trust Company of New York for a similar amount. One million dollars of the money are to be used in double-tracking the road from Jersey City to Paterson, work on which was begun some time ago; in filling in the long trestle work near Jersey City, and extending the Lodi Branch to Maywood, where it will again connect with the main line. One million dollars are to be used for paying off mortgages and other indebtedness, and the third million is to be held in reserve for making improvements not yet definitely determined upon.

Herkimer, Newport & Poland.—Surveys are in progress for the proposed extension of this New York road into the north woods of the Adirondack Mountains.

Rumford Falls & Buckfield.—This Maine railway has been sold to a syndicate, which, it is stated, will extend it from Canton to Rumford Falls, 15 miles.

Croton Valley.—A meeting of the stockholders of this company was held at 48 Wall St. recently, at which steps were taken toward the issuing of bonds to pay for the construction of the road. Contracts have already been made and the work of building the road will begin in a very short time. The line of this new railway extends from Croton Landing, opposite Haverstraw, through the county of Westchester to the State line, a distance of about 23 miles. The stockholders will meet again in January to elect directors.

Emmittsburg.—The preliminary survey has been completed for the extension of this railway from Emmittsburg, Md., to Gettysburg, Pa.

Projects and Surveys.

Newport & Sherman's Valley.—A correspondent writes us that this road is projected to run from Newport, Pa., via Elliottsburg and Andersonburg, to New Germantown, Pa., a distance of 30 miles. David Gring is President and A. P. W. Johnson is Chief Engineer.

Marblehead & Danbury.—Chartered in Ohio to build a railway from Marblehead to Danbury, a distance of 10 miles. S. Sloss, of Marblehead, O., is at the head of the enterprise.

New York, Philadelphia & Chicago.—A charter has been granted to this company to construct a railway 96 miles long in Venango, Clarion, Jefferson and Clearfield counties, Pennsylvania. Among the incorporators are Samuel Plumer, of Franklin, Pa., and Jas. E. French, of Cleveland, O.

Gouverneur & Adirondack.—This company has been incorporated with a capital of $150,000 to construct a 13¼-mile railway from the Rome, Watertown & Ogdensburg R. R. at Gouverneur to Edwards, N.Y. The directors are: F. H. Leonard, Jr., J. L. Hinds, A. W. Kilby, E. C. Cooke, F. B. Roblin, J. A. Fox, Syracuse; Frank Watts, Watertown.

Cumberland & Washington.—It is proposed to begin the construction of this line at once.

Casselman Lumber & Pulp Co.—This company has purchased a large tract of timber land in Casselman Valley, Md., and will construct a line of narrow gauge railway to open it up. The officers are: Geo. L. Wellington, Baltimore, Md., President; Wm. R. Getty, Treasurer, and Chas. Brown, Secretary.

Iron Range & Huron Bay.—Milo H. Davis, of Aroon, Barago Co., Mich., Chief Engineer, writes as follows:

The preliminary surveys have been completed and location is now in progress for this line, which is projected to run from Huron Bay to Champion, Mich., 60 miles. The work is generally light, maximum grade 50 ft. per mile and maximum curve 5°. The road is being built for the iron ore trade. The contract for construction has been let to Wallace Dingman, of Battle Creek, Mich., the road to be completed in August, 1891. C. H. Buhl, of Detroit, Mich., is President.

SOUTHERN.—Existing Roads.

Georgia Southern & Florida.—Grading on the Macon & Birmingham R. R. has been completed to La Grange, Ga., and tracklaying is being pushed as fast as possible. Work on the division from La Grange to Birmingham, Ala., will commence as soon as the first section is finished.—Work has been commenced on the line from Tipton to Thomasville, Ga.

Florida Midland & Georgia.—The contract will be let soon for the section between the Georgia State line and Deadman's Bay, Fla. Arthur Pew, of Talbotton, Ga., is Chief Engineer.

Danville & New River.—This narrow gauge railway, running from Danville, Va., to Patrick C. H., Va., has been sold to J. W. Brown, of Baltimore, Md., who is said to represent the Richmond & Danville R. R. Co.

Norfolk & Western.—This company is surveying a belt line around the city of Radford, Va.

Birmingham, Sheffield & Tennessee River.—It is expected that the line from Margerum to Riverton, Ala., will be opened for traffic by Sept. 15.

Empire & Dublin.—Work is now being pushed on the extension from Hawkinsville to Grovania, Ga.

Projects and Surveys.

Kentucky & Cumberland.—Wm. McCloy, of Frankfort, Ky., Chief Engineer, writes as follows:

This road is projected to run from Frankfort, Ky., via Lawrenceburg, Springfield, Lebanon, Columbia and Burksville, Ky., to Sparta, Tenn., a distance of 140 miles. The preliminary surveys for the greater portion of the line have been completed and the location will begin at once. The route is through a rolling limestone country, comprising some of the best farming and stock growing land in the State. The work is generally easy; maximum grade, 66 ft. per mile, and maximum curve not to exceed 6°. The principal business will be in farm products, stock, coal, timber, iron and oil. It is expected to let the contracts for building the northern section in a few weeks. Z. F. Smith, of Louisville, Ky., is President.

Kinniconick & Freestone.—Wm. B. Prather, of North Vernon, Ind., Civil Engineer, writes us as follows:

This road is to run from Kinney, on the Chesapeake & Ohio R. R., up Kinniconick Creek, Ky., a distance of 9 miles. It is being built in the interest of the Kentucky Freestone Co. and the Chesapeake & Ohio R. R. Co., and will open up the quarries and timber lands along the route. The maximum grade will be 60 ft. per mile and the maximum curve 6°. About 4 miles of the line have been graded and 3 miles of track laid. The contractors, J. P. Reynolds & Co., of Rock Island, Ill., have about 200 men and 30 teams at work on the road. The road will probably do only a freight business.

Portsmouth & Norfolk Belt.—A new survey is being made for the proposed belt line around the cities of Portsmouth and Norfolk, Va.

Radford & Floyd Court House.—A railway is projected from Radford to Floyd C. H., Va. J. D. Peters, of Radford, Va., is interested.

Kramer & Bowdon.—A company has been formed to build a railway from Kremar to Bowdon, Ga., 18 miles.

Cincinnati, Athens & Alabama.—Chartered in Tennessee to build a railway in McMinn Co.

Bedford & James River.—W. S. McKinney, of Bedford City, Va., Secretary, writes as follows:

This road is projected to run from Bedford City to James River, near Big Island, a distance of 20 miles. The preliminary surveys have been completed and the company is nearly ready to commence location. The principal business will be in tobacco, coal and timber. Considerable local aid has been secured. It is expected to let contracts about Oct. 1. W. W. Beroy is President.

Scotch Coal, Iron & R. R. Co.—This company has purchased for immediate development over a quarter of a million acres of timber and mineral land in West Virginia, lying in Wyoming and McDowell counties, and will proceed at once to develop it. A company has already been incorporated under the laws of the State to construct a railroad from Charleston to connect with the Norfolk & Western R. R., and construct railways which will penetrate the lands of the company. This will open up a large area of undeveloped land in this State and bring to market some of its finest coal and timber.

Tombigbee.—Nearly all of the right of way has been secured for this railway, which is projected to run from Columbus, Miss., to Decatur, Ala.

NORTHWEST.—Existing Roads.

Wisconsin Midland.—Miller & Loomis, of Chicago, Ill., have the contract to build this line from Fond du Lac, Wis., north along the east shore of Lake Winnebago, and work is already in progress. N. Boardman, of Fond du Lac, Wis., is Chief Engineer.

Duluth, Red Wing & Southern.—A press dispatch says that work will soon commence at Duluth, Minn., and that the first 15 miles of this road south will be built at once.

Calgary & Edmonton.—Tracklaying has commenced at Calgary, Alberta, and will be rapidly pushed north.

Chicago, Milwaukee & St. Paul.—The survey for the extension from Chamberlain, S. Dak., through the Sioux reservation to the Black Hills, has been completed.

Projects and Surveys.

La Salle & Bureau Co.—Chartered in Illinois to build a line of railway from La Salle, Ill., to Hall, Ill. Among the incorporators are: Edward C. Hegeler, Andrew J. O'Connor and Chas. Deisterweger, all of La Salle.

Antikokan Iron Range.—This company will make an application to the next Canadian Parliament for a charter to build a railway from a point on the Canadian Pacific Ry., between Carlstadt and English River, to Sturgeon Falls, Ont.

Duluth, Pierre & Black Hills.—It is announced that work will begin at once on this railway from Pierre to Aberdeen, S. Dak. The projectors of the enterprise are all capitalists interested in the Northern Pacific R. R.

SOUTHWEST—Existing Roads.

Missouri Pacific.—A large force of men and teams is at work on the extension of the Houston, Central Arkansas & Northern R. R. from Columbia to Alexandria, La. The line is to be completed this season.

Houston & Texas Central.—Tracklaying has been completed on the branch from Hutchins to Lancaster, 5 miles.

Haines, Hamilton & Kingston.—E. T. Haines, of Kingston, Mo., writes us as follows:

This road is projected to run from Hamilton to Kingston, Mo., 12 miles. The route is through an undulating prairie country affording easy work; maximum grade, 50 ft. per mile, and average curve 3°. The principal business of the road will be in coal, farm products and lumber. About 150 men and 70 teams are now at work on the line. It is expected to commence tracklaying about Oct. 10, and to have the road completed Oct. 30. The contractors are Judson Kingsley, of Troy, N. Y., and P. D. Walton & Co., of Cameron, Mo. T. M. Long is Chief Engineer.

Camden & Alexandria.—W. R. Smith, of Camden, Ark., Chief Engineer, writes as follows:

York, Woods & Loonan, of Wichita, Kan., have the contract for building this road from Camden, Ark., to Eldorado, Ark., to be completed March 1, 1891. The work is easy, maximum graded 1% and maximum curve 3°. The principal business will be in farm products and lumber. C. C. Henderson, of Camden, Ark., is President.

Projects and Surveys.

Pan Handle, Corsicana & New Orleans.—Chartered in Texas to build a railway from Ft. Worth, Tex., to Alexandria, La., a distance of 200 miles. Among the incorporators are: S. W. Johnson and Stephen Smith, of Corsicana, Tex.

St. Louis, Cape Girardeau & Memphis.—Surveys are in progress for this road which is projected to run from Cape Girardeau to Memphis, Tenn. J. T. Brooks, of Cape Girardeau, Mo., is Chief Engineer.

Kearney & Sheridan.—Surveys are in progress for a railway from Kearney to Sheridan, Ark., 15 miles. J. J. Martin, of Pine Bluff, Ark., is Chief Engineer.

Guthrie, Reno City & Fort Reno.—The surveys have been completed for this railway from Guthrie to Fort Reno, Ind. Ter., 41 miles. C. J. DuBois, of Reno City, Ind. Ter., is Chief Engineer.

Lampasas, Burnet & Southwestern.—This road which is projected to run from Lampasas, Tex., via Burnet, to Llano, Tex., 58 miles, will, it is stated, soon commence construction. The officers are: R. A. Huffman, of Kansas, President; R. E. Maddo, of Fort Worth, First Vice-President; J. Moon, of Kansas, Second Vice-President; M. A. McLaughlin, of Fort Worth, Secretary; S. F. McClure, of Ohio, Treasurer; W. A. Disborough, of Dallas, General Manager, and W. Hunstable, of Dallas, Land Agent and Auditor.

ROCKY MT. AND PACIFIC.—Existing Roads.

Union Pacific.—This company now has about 1,500 men at work on the Portland & Puget Sound R. R., and will soon increase the force to 4,000. The route has been definitely decided upon. It will follow the Columbia River to Kalama, from Kalama to Centralia it will parallel the Northern Pacific R. R., and from Centralia it will run to Olympia, and thence to Tacoma.—The work on the Oregon Short Line & Utah Northern Railway Company's extension southwest from Milford, Utah, to Pioche, Nev., progresses steadily, and all contracts will be finished by Oct. 15. The grade from Milford to Clover is finished, and all other parts of the grade from Clover to Dutch Flat are practically finished, with the exception of the tunnels. There are six tunnels on the road, the longest being 680 ft. in length; there remains about 150 ft. more of this tunnel to be completed.—Tracklaying will soon begin on the Cheyenne & Northern extension.

Oregonian.—It is announced that work on the extension from Coburg to Springfield, Ore., will be commenced shortly, and the line completed this winter.

Oregon & Washington Territory.—The surveys for the line from Hunt's Junction, Wash., to Portland, Ore., are nearly completed.

Pecos Valley.—About 40 miles of the grading have been completed and 12 miles of track laid. Work is being pushed rapidly north to Eddy, New Mex.

Great Northern.—This company expects to have 175 miles of its line west to the base of the Rocky Mountains completed by Jan. 1. Work will be continued throughout the winter, and it is expected to complete the line to the summit by next spring. Surveyors are now at work locating the line through the mountains.

San Francisco & San Joaquin Valley.—It is announced that work will be resumed at once on this road from Rodger's Station, on the Atlantic & Pacific R. R., south through the San Joaquin Valley to tidewater, 380 miles. In regard to the project, I. R. Wilber, President, says:

"We estimate that it will cost about $10,000,000 to build such a line as we propose building. Of course one could be constructed for much less, but it is the intention of the San Francisco & San Joaquin Valley Co. to build and equip a line first-class in every respect. The route over the mountains will necessarily be an expensive one. Between $5,000,000 and $6,000,000 will also be required to extend the road from tidewater to San Francisco, or in the neighborhood of $17,000,000 to complete the entire work. In relation to preliminary work we have already completed grading on about 70 miles of the road through the San Joaquin Valley, and about two years ago did some little work up in the mountains. We are now in a fair way to push right ahead with the work of construction, and I feel assured that I can say that the road will be well on toward completion within the next two years."

The San Francisco & San Joaquin Valley Ry. Co. was organized and incorporated 3 or 4 years ago. The capital stock is $15,000,000. The officers of the company are: Isaac R. Wilbur, President; Louis F. Monteagle, Secretary; Timothy Paige, W. J. Little and John S. Wilbur directors.

Projects and Surveys.

Butte City, National Park & Southwestern.—N. C. Ray, of Butte City, Mont., Chief Engineer, writes as follows:

This road is projected to run from Butte City, southeast via Pipestone Pass and the Jefferson, Ruby and Madison Vallies to the southern boundary of Montana, near National Park, a total distance of 150 miles. About 40 miles of the preliminary survey has been completed. The route crosses the main range of the Rocky mountains twice and one intermediate range. The work is heavy; maximum grades 2%, and maximum curve 16°. There will be 10 small tunnels on the line. The principal business will be in coal, coke, lumber, iron ore, machinery, and bullion. Contracts for construction will be let soon. Lee Mantle is President.

Tacoma & Port Townsend.—Surveys are in progress for a railway from Tacoma to Port Townsend, Wash. Ogden & Bosworth, 1342 Pacific Ave., Tacoma, Wash., are the engineers.

Port Angeles Central.—This company has advertised for 10,000 standard gauge cross-ties to be delivered along its right of way at Port Angeles, Wash. The road is to run from Port Angeles, Wash., to the Columbia River. James Wickersham, of Tacoma, Wash., is at the head of the enterprise.

Perry Park.—Chartered in Colorado to build a railway from Sedalia to Palmer's Lake, Colo. Among the incorporators are: Chas. A. Roberts and J. D. Winters of Denver, Colo.

FOREIGN.

United States of Colombia.—A contract between the Colombian Government and J. L. Cherry, of Milwaukee, Wis., for the completion of the Cauca R. R. from Buenaventura to Cali and Manizares was signed in Bogota on Aug. 26. The contract includes the privilege of building extensions to the Gulf of Darien on the north and to the frontier of Ecuador on the south, and from the Cauca River to the Magdalena River and the navigable waters of the Amazon River. The Government guarantees a subsidy of 5 per cent. in gold for 18 years on $63,000 gold per mile, with exclusive privileges for 70 years in a zone extending for 24 miles on each side of the railroad track, with the preference to take all the public lands and all the gold, silver, coal and other mines inside this zone. The contract also includes exemption from duties and taxes.

Africa.—The commission of inquiry which has been investigating trans-Saharan railway schemes has approved a route from Constantine and Biskra, in Algiers across the desert to Lake Tchad. This route is by way of Timassinise and Anguid, and traverses the Tonaregs country. Its length is given as 2,000 miles. The project is said to be backed by the Banque Russe et Francaise.

CITY TRANSIT.

Pneumatic Railways—*Washington, D. C.*—The Judson Pneumatic Railway will probably be opened early in October.

Horse Railways—*Westfield, Mass.*—Extensions will be made.

Bloomington, Ill.—The Street Railway Co. has discarded its Daft electrical system and returned to the humble mule as a source of power.

Wauwatosa, Wis.—The Milwaukee City Railway has received permission to lay tracks through this town. Work will begin immediately.

Dummy Railways—*Birmingham, Ala.*—The entire right of way to St. Clair Springs, a distance of 30 miles, has been secured.

Walla Walla, Wash.—It is reported that all but four miles of right of way for the motor line between Walla Walla and Milton has been secured.

Cable Railways—*St. Louis, Mo.*—The Cass avenue line will be changed to a cable railway as soon as the necessary material can be obtained.

San Diego, Cal.—A cable railway is talked of for the eastern part of the city.

Seattle, Wash.—Work on the James Street Trunk Line will be started immediately. The line consists of ¾ miles of double 4-ft. guage track; the cables will be 1¼ ins. in diameter laid with the Langlay twist. The power house now building, will contain two 24 × 48-in. Lane & Bodley engines with 16-ft., 24-ton fly wheels. The shaft will be 14 ins. in diameter, and on it will be a spool 5 ft. 9 ins. in diameter with 18 groves for a 2-in. rope, the ropes running from the engines to an 18 ft. wheel with a 4-ft. 9-in. face and 16 grooves. In this way power is transmitted from the engine to the cable drivers, which are 10-ft. Walker differential wheels. Seventy revolutions of the engine will give a cable speed of 8 miles an hour. The fly-wheels of the engine will be connected by a rope gearing with the dynamos used for degenerating the currents employed on the electric lines of the company.

All the lines in this city propose making extensions as soon as the necessary supplies can be procured.

Electric Railways.—*Fort William, Ont.*—A line is proposed.

Buffalo, N. Y.—Work will be pushed on the different streets as much as possible. The company has contracted for the material for 25 miles of single track. The cars will be 35 ft. long, with vestibules and double trucks.

Hagerstown, Md.—The Land Improvement Co. has applied for right-of-way on several streets.

Covington, Ky.—The Cincinnati, Covington & Rosedale Street Railway will probably construct a line here shortly.

Maumee, O.—An electric line will be built at once to Toledo, 12 miles distant.

Des Moines, Ia.—The Belt Line has been purchased by the Electric Street Railway Co., which will at once introduce an electrical plant.

St. Louis, Mo.—The Northern Central Railway will adopt the overhead trolley system.

Winnipeg, Man.—A line is proposed.

Sacramento, Cal.—The Board of Trade has indorsed a project for the introduction of the overhead electrical system on the street railways.

Inclined Railway.—*Pittsburg, Pa.*—The inclined line that was projected some time ago, but afterward given up, has been again revived, and it is now proposed to run the track through a tunnel in order to avoid the heavy grades.

New Companies.—Seattle, Wash., City Railway Co., capital, $600,000. Chicago & Jefferson Urban Transit Co.; capital, $1,000,000; incorporators, J. Johnston, Jr., H. Vannatta, F. H. Dickey, F. H. Baker and others. Rapid Transit Co., Galveston, Tex.; incorporators, W. Snyder, J. J. Harris and others. Uniontown, Pa., Street Railway Co.; capital, $50,000; directors, A. D. Boyd, G. A. McCormick, N. Ewing and others. Peerless Transit Co., Cleveland, O.; capital, $250,000; incorporators, J. A. Scott, A. H. Balsley, J. G. Hull, W. R. Carrahan, J. J. McNyler.

BRIDGES, TUNNELS AND CANALS.

Bridges.—*Tonawanda, N. Y.*—A bridge over Tonawanda Creek, to cost $30,000, is being talked of.

Roanoke, Va.—The Roanoke Gas & Water Co. will build an iron bridge over Roanoke River.

Wheeling, W. Va.—Ground has been broken on the Ohio shore for two more piers for the new Back River bridge. These piers will consist of a stone foundation on which two heavy iron columns will rest, and will be completed in a short time. The east pier of the bridge has been completed, and work on the other piers and abutments is being rapidly pushed. The stonework will all be completed in about six week, when the iron work will be put on at once.

Louisville, Ky.—The iron for the second span of the new Jeffersonville and Louisville bridge is rather tardy in arriving, and work has been suspended on the false work until the iron arrives. 3,000 ft. of the northern approach have been erected, and the remaining 1,000 ft. will be completed within two weeks. The engines and cars can run up on the bridge as the work progresses and deliver the iron more conveniently. The caisson for pier No. 4 is nearly completed. Bed-rock has been reached, and the rock is being cut away so as to give the caissons a firmer foundation.

Minneapolis, Minn.—The following bids were received for fourteen 52-in. plate girders to carry the tracks of the Great Northern Ry. over Fifteenth Ave.; estimated weight, 240,000 lbs.:

	Per lb., f. o. b. cars, Min'is.	Per lb., erected ready for ties.
A. S. Bayne & Co., Minneapolis	3.8 cts.	4.3 cts.
King Iron Bridge & Mfg. Co.	3 98	4.28
Schiffler Building Co.	3.8	4.25
Wrought Iron Building Co., Canton, O.	4.16	4.66
Chicago Forge & Bolt Co.	3.395	3.675
Chicago Bridge & Iron Co.	3.75	4.00
A. & P. Roberts & Co., Philadelphia	3.73	4.43
Wisconsin Bridge Co.	4.125	4.70
Milwaukee Bridge & Iron Works	3.84	4.24
Pottsville Iron & Steel Co.	3.99	....
Lassig Bridge & Iron Works	3.425	3.90
Edge Moor Bridge Works	3.55	4.15
F. F. Harrington, Minneapolis	3.8	4.15
Keystone Bridge Co.	3.69	4.3

The contract was awarded to Chicago Forge & Bolt Co., the work to be done in seventy days.

Dallas, Tex.—A bridge will be built over the Trinity River.

Denison, Tex.—A 1,000 ft. viaduct will be constructed over the yards of the Missouri, Kansas & Texas Railroad and the Houston & Texas Central Railroad.

Sioux City, Ia.—Work has been commenced on the railroad bridge, which the Pacific Short line will build across the Missouri River here. Material for the bridge has been arriving for some time. The contract was let in Chicago some time ago to the Phœnix Bridge Co. The bridge will be low and will have two draws.

Faribault, Minn.—Bids will be received until Sept. 15 for constructing two iron bridges over Cannon River. L. Hawley, City Recorder.

WATER-WORKS.

NEW ENGLAND.

Adams, Mass.—Superintendent Waters has submitted a report to the Water Commissioners for increasing the water supply. He recommends the sinking of a well about 50 by 100 ft. and deep enough to reach the river level, into which springs will discharge. Then by pumping it is proposed to force the water into the present reservoir in times of low water. The estimated expense is $10,000.

Springfield, Mass.—The city has sold $125,000 of 30-year 3½% bonds to the Third National Bank.

Meriden, Conn.—Plans have been perfected by the Water Committee for pumping water from Pratt's Pond, at Miller Bros. factory, into the Pratt street main. An extra pump is being put in at this point.

New Britain, Conn.—Mayor Pease has appointed Senator Corbin, A. W. Rice, Thomas S. Bishop, and others, a committee to confer with the Water Commissioners concerning the laying of a main from Shuttle Meadow and constructing a dam.

Norwalk, Conn.—A. H. Camp, Secretary Board of Water Commissioners, informs us that the contract for furnishing the cast-iron pipe and special castings has been awarded to R. D. Wood & Co., of Philadelphia, Pa., at an average price of $27.99 per gross ton, delivered.

MIDDLE.

Amsterdam, N. Y.—The following is from A. H. De Graff, Chief Engineer:

Our supply was short through July and August. We cut off the mills and street and lawn sprinkling. We are now constructing a conduit line of 18 and 20-in. pipe, 13 miles long, from Hans Creek, Providence, Saratoga Co., capacity 5,000,000 gall. per diem. It will be finished Nov. 1, 1890. We have now plenty of water from our old lines and from a temporary conduit from the Chuctanundo Creek.

Cohoes, N. Y.—A considerable amount of 8 and 6 in. pipe has been ordered laid.

Edgewater, S. I., N. Y.—Woodbury & Moulton, of Portland, Me., are offering $85,000 of 6% first mortgage gold bonds for sale.

Glens Falls, N. Y.—Bonds for $45,000, bearing 5% interest, have been sold. The money realized from the sale is to be used to improve the works.

New York, N. Y.—The contract for building Reservoir D, at Carmel, has been awarded to M. S. Coleman, at $397,262.50. The engineer's estimate of the cost was $418,810. The daily flow under the staging erected in the aqueduct has been increased since Aug. 27 to 37,500,000 galls. per day. It is intended shortly to raise the volume to 42,000,000 galls. daily, which will keep the Central Park reservoirs at a proper height.

Sherburne, N. Y.—The construction of the proposed reservoir has been deferred until next year, owing to difficulty in obtaining the necessary land.

Altoona, Pa.—A vote is to be taken on the question of increasing the water supply.

Beaver Falls, Pa.—The following is from J. W. Ramsey, Superintendent Union Water Co.:

The Beaver Falls Water Co. sold its plant on May 15 to H. W. Hartman, and the works are now known as the Union Water Co.'s. Improvements are being made in connection with the Valley Water Co., which is to supply Rochester and other towns in the Beaver River Valley. Merritt Greene, of Beaver Falls, is at the head of the latter company. A dam is being built on Beaver River, and Holly water-power pumps, and a Hyatt filter, will be used. The contracts are all, or nearly all, let.

Braddock, Pa.—The City Council has taken favorable action on the recommendation of Superintendent George L. Jones to build a new 4,000,000-gall. reservoir near North Braddock.

Curwensville, Pa.—We have received the following from C. W. Boyce:

The Raftsman Water Co. has contracted with the town for a gravity system of water supply for fire protection and domestic purposes. Joseph H. Young, of 1,404 S. Penn Sq., Philadelphia, Pa., is the Engineer in charge.

Huntington, Pa.—A 3,000,000-gall. reservoir is being built by the company, without contractors, under direction of its superintendent, Irvin W. Hoffman. The bottom will be covered with 8 ins. of concrete.

Lancaster, Pa.—E. F. Frailey, Superintendent, has sent the following:

A 20-in. pipe, 115 ft. long, has been laid from the reservoir to the stand-pipe, thus putting the whole town under stand-pipe pressure. An ordinance providing for an issue of $275,000 of bonds is now before the Council. If it is passed by them and ratified by the citizens a 40,000,000-gall. reservoir will be built on College Hill and a mile of 36-in. force main laid to it.

Lebanon, Pa.—R. J. Shirk, Supt., informs us that the proposed reservoir on South Mountain will probably not be built before next summer, if then.

Milton, Pa.—President R. F. Wilson has awarded the contract for 40 new hydrants to the Eddy Valve Co., of Waterford, N. Y.

Williamsport, Pa.—W. H. Bloom, Secy., has sent the following:

The Mosquito Creek Reservoir is just being completed by the Citizens' Water & Gas Co. It has a capacity of 20,000,000 galls., and is formed by a dam 1,250 ft. long and 16 ft. high, of earth with stone filling on the dry slope. The Williamsport Water Co. will build their reservoir next year. [The two companies are operated under the same management.—Ed.]

Cumberland, Md.—Jas. P. Gaffney, City Engineer, has sent the following:

We have not yet put in a filtering plant, but as soon as our finances will permit we will put in the National system. Our supply-pipe has been extended to a point about 1,330 ft. further up the Potomac River, above all possible pollution from the city's sewage. Heretofore we had been taking our supply a few hundred feet below the mouth of a run which carried the sewage of nearly one-half of the city. The new supply pipe is of vitrified terra cotta, 2 ft. in diameter, buried on an average 9 ft. below the ground, and leads to the pump-well with a gradient of 0.13%. Nearly all our 3 and 4-in. mains have been replaced with 6-in.

Ocean City, Md.—We have received the following information from Charles F. Holland:

The water supply scheme talked of for this place is in embryo. Plans have not been perfected as yet.

Rockville, Md.—The West Park & Loan Co. has been incorporated at Alexandria, Va. Vice-President, W. W. Dudley; Treasurer, S. D. Luckett; Attorney, H. M. Talbott. The company has been organized to develop lands recently purchased near Rockville, and proposes later on to establish a system of water supply, etc. Capital stock, $500,000.

SOUTHERN.

Hinton, W. Va.—We have received the following:

The construction of the works will be commenced about Sept. 15. They are to be completed by March 15, 1891. The Glamorgan Co., of Lynchburg, Va., will build them for the Hinton Water-Works Co. President and Superintendent and Engineer, F. R. Van Antwerp; Secretary, H. Ewart; Treasurer, J. A. Riffe. Two Smith & Vaile pumps, of 500,000 galls. daily capacity, respectively, will raise water from the river to a 1,000,000-gall. reservoir. There will be 2¾ miles of 8 in. pipe and about 30 hydrants. Estimated cost, $75,000. The city will pay an annual rental of $900 per year for 30 hydrants. Population, 1,900.

Oxford, N. C.—H. C. Herndon has sent us the following:

No practical steps toward securing works have been taken. The proposed plan is to get some party to construct, own and operate works, the town and citizens paying a certain rental. Correspondence with such parties is solicited.

Durham, N. C.—The Durham Consolidated Land & Improvement Co. has been organized by Julian Carr, President; A. B. Andrews, Vice-President; R. H. Wright, Secretary and Treasurer, and John Yancey, Jr., General Manager. Capital stock, $1,000,000. The company has purchased about 800 acres of land in and out of the city limits, and proposes to establish a system of water supply, etc.

Charleston, S. C.—The water company proposes soon to begin boring another well. Three wells have already been put down.

Atlanta, Ga.—Hall Bros. have been awarded the contract for making the preliminary surveys for the new water supply. The two sources to be investigated are the Soque and Amiclola Rivers.

De Land, Fla.—The De Land Water-Works Co. has been incorporated by G. W. Fisher, S. B. Wright and J. A. Stewart. Capital stock, $25 000.

Eustis, Fla.—The town has bound itself to pay $1,000 per year for fire protection. The plan is to raise $20,000 in cash at once among the citizens, and then issue $30,000 of long date bonds.

Madison, Fla.—J. A. Durst may be addressed for information regarding the projected works.

Troy, Ala.—George H. Leland, Engineer Water Supply Co., states:

The company proposes to sink an artesian well from which to supply the city with water. Work will be started as soon as the machinery is received.

Clarksville, Tenn.—The Land & Improvement Co. has purchased 14,000 ft. of 6-in. pipe to extend its mains out Greenwood Ave to the new addition to the city.

Knoxville, Tenn.—President R. N. Hood has introduced an ordinance asking for authority to place a bonded debt of $500,000 upon their property, the money to be used for improvements. The original contract between the city and the company stipulates that the company shall not mortgage its property for more than $150,000.

South Pittsburg, Tenn.—The following is from F. P. Clute, Supt.:

The South Pittsburg City Co. sold their water-works on July 1 to the South Pittsburg City Water Co. Plans are being made for a 300,000-gall. reservoir, and several miles of 12 to 6-in. pipe will be laid. The future supply will be from mountain springs by gravity, together with pumping from the Tennessee River when necessary. An effort is being made to bond the works for $30,000, in order that they may be put in first-class shape.

NORTH CENTRAL.

Conneaut, O.—The Eddy Valve Co., of Waterford, N. Y., has been awarded the contract to furnish the valves and hydrants for the new works. Between 75 and 100 hydrants will be set at once. The franchise has been granted to, and the works will be built by, the Hydraulic Construction Co., Equitable Building, New York, under the supervision of the General Manager, H. De. C. Richardson.

Carrollton, Ill.—The citizens have voted to expend $20,000 for establishing a water supply. Water has been secured at a depth of 1,600 ft. John Sharon can furnish information.

Lebanon, Ill.—The City Council has voted to levy a tax of $2,000 to make up the appropriation of $4,000 for the new works.

NORTHWESTERN.

Emmetsburg, Ia.—A strong flow of water has been secured from the artesian well at a depth of 250 ft.

Exira, Ia.—A small system of works is to be put in Estimated cost, $3,000.

Toledo, Ia.—Mayor A. M. Beal has sent us the following:

Contracts will be let on Sept. 23. Work will probably be commenced on Oct. 1, and completed about May 1, 1891. Chairman of the Water Committee, A. M. Beal. Engineer, George C. Morgan, of Chicago, Ill. Water will be pumped from wells to a stand-pipe. Estimated cost, $17,000, to be procured from town bonds. Population, 1,900.

Washington, Ia.—City Clerk J. J. Kellogg has sent us the following information:

The works are to be built by the town. The date for letting contracts has not been decided upon. Miller & Co., of Chicago, Ill., are sinking the wells. F. E. Lamphers is Chairman of the Water Board. D. C. Kyles is the Engineer. Water will probably be pumped from an artesian well to a stand-pipe and reservoir. Population, 3,300.

Wilton, Ia.—By special election it has been decided to issue $14,000 of bonds for constructing works.

Superior, Minn.—The mayor has signed the resolution providing for the laying of water mains on Broadway.

Aurora, Neb.—A proposition to issue $7,000 of additional bonds has been carried by a majority vote of 79.

Humboldt, Neb.—Fremont Turner, of Nevada, Ia., has been awarded the contract for putting in complete works at $6,850. The supply is to be taken from springs. The works are to be completed by Jan. 1, 1891.

SOUTHWESTERN.

St. Louis, Mo.—Water Commissioner Holman has detailed to the Water Board a proposition to erect a stand-pipe and operate a water-works plant in the locality of the poor house, insane asylum and female hospital. They are supplied with water at present, but owing to the high location the supply is sometimes uncertain. With this plant Mr Holman also suggests that water could be furnished to the surrounding locality, which is too high to be effectually supplied with water from the present city supply.

Hempstead, Tex.—Address C. C. Amsler for information regarding the projected works.

San Antonio, Tex.—The date for taking the vote on the question of issuing $?,000,000 of 5% bonds for purchasing the existing works is Sept. 30.

North Denver, Col.—Citizens propose sinking one or more artesian wells and putting in a private water supply system. Dr. H. C. Snitcher, W. D. Todd, Capt. L. W. Cutter and others are interested.

Trinidad, Col.—The proposition to issue $156,000 of bonds for constructing a new system of works has been carried by a large majority vote.

PACIFIC.

Aberdeen, Wash.—The City Council has had plans prepared for a new system of works to cost about $50,000. The question of issuing bonds for that amount is to be voted upon. The scheme embraces a 2,000,000-gall. pumping plant, which will pump water into a tank 230 ft. above the city. The two private systems now in use will be bought up and probably utilized. A reservoir will also be constructed.

Heppner, Ore.—The citizens have voted to bond the town for $5,000, to continue sinking the artesian well. It is now down about 600 ft.

Los Angeles, Cal.—The following resolution has been adopted by the Board of Health:

That the condition of the water supplied to the citizens by he Citizens' Water Co. is such as to demand of the authorities of the city immediate attention, that permanent relief may be afforded in improving the *quality* furnished by said company, and the Council is asked to take immediate steps.

Los Angeles, Cal.—The Los Angeles City Water Co., has been defeated in the Superior Court in its attempt to prevent the Sierra Madre Water Co., represented by E. L. Stern and the East Side Water Co., from laying mains supply water in the city. It seems probable that the case will be carried to the higher courts. The opinion of Judge J. W. McKinley occupies nearly five columns of the Los Angeles *Evening Express* of Aug. 27. The decision is based on the opinion that the city had no right to grant an exclusive franchise to the City Water Co., and that the ratification of the same by the Legislature was unconstitutional.

San Jose, Cal.—The Glen Weber Water Co. has filed articles of incorporation. Capital stock, $2,000,000. Its purposes are to furnish water for drinking and mechanical power to the cities of San Francisco, Oakland and San Jose. The capital stock is all subscribed.

CANADA.

Antigonish, N. B.—George A. Vye, of Moncton, N. B., has been awarded the contract for the construction of the new works. Six miles of pipe are to be laid. The contract price is about $40,000.

Sainte Cunegonde, P. Q.—G. Ducharme, City Treasurer, informs us that the recent issue of bonds were for the construction of water-works, and sold at par with interest at 4½%. An unofficial report some time since gave the amount as $400,000. Private works were built here by Berger & Berfue in 1879.

Woodstock, Ont.—A large majority vote in favor of was taken on Sept. 1, expending $105,000 for bringing spring water into the town in adequate quantities and for extending the existing mains.

New Westminster, B. C.—Arthur Hill, engineer of the new works, will receive tenders for supplying the material for the distribution system until Oct. 20. It will include about 1,000 tons of cast iron pipe and specials, valves, valve boxes, hydrants, relief valves, etc.

ARTESIAN WELLS.

Barnesville, Ga.—Bids are reported to be wanted by McMichael & Hardy for sinking a well.

Columbus, Ga.—A movement is on foot to drill a well

Rochelle, Ga.—A citizens' movement has been inaugurated to sink a well.

New Orleans, La.—It is reported that the Louisiana Electric Light Co. contemplates sinking a well.

Normal, Ill.—The Trustees of the Board of Education have awarded the contract for sinking a well for supplying the school to Moore & Thurston, of Parke County.

Ballard, Wash.—Several wells have already been sunk and others are projected.

IRRIGATION.

Garden City, Kan.—The Garden City Irrigation Co. has been chartered for the purpose of purchasing irrigating canals in Kearney and Finney counties, improving the same by tapping the underflow of streams, as well as by taking the overflow, maintain said canals, build or extend existing canals or laterals, construct reservoirs, sell water for irrigating purposes or to be used as power, cut and sell ice from its reservoirs, ponds or canals, buy and sell lands within its irrigable territory or farm the same. Capital stock, $300,000. The directors are: John A. Stevens and Benjamin F. Babcock, of Garden City; Thomas W. Pelham, F. W. Denny and J. J. Barrelle, of Leoti, Kan.

Ellendale, N. Dak.—The first practical step toward irrigation in Dickey Co., has been taken by Dr. M. F. Merchant, of Ellendale, contracting to construct an artesian well at Yorktown and furnish water for irrigation purposes to four farmers of that town. He charges them $1 per acre per annum for 10 years and guarantees sufficient water for the 800 acres which they have under cultivation. His total revenue will be $8,000. The total cost of sinking and piping the well including the purchase of a drilling outfit, will be about $2,400. Experts estimate that a good artesian well will irrigate 1,200 to 1,500 acres. Dr. Merchant will begin operations immediately. Several other enterprises of the same kind are being considered.

Randall Co., Tex.—The Hoffman Irrigation Co. has been incorporated with a capital stock of $5,000.

Alamosa, Col.—Surveys have been made for a 20-mile extension to the San Luis Canal, and the contract for excavation has been awarded to Mr. Chapman. The canal's supply is taken from the Rio Grande River, 15 miles above Alamosa. T. C. Henry, of Denver, is interested in the canal.

Greeley, Col.—The Larimer and Weld Reservoir Co. has been incorporated by D. B. Wyatt, Horace G. Clark and Jael Roullard. Capital stock, $75,000. The ditch will run through sections 25, 31 and 36. The water will be brought from the Cache la Poudre River.

Julesburg, Col.—Two miles of the Froid and Belmont canals have been completed. The remainder of the work is to be completed by April 1, 1891.

California.—Surveyors will be set to work early in September to run lines for a canal from Owens River to Salt Wells Valley, Inyo Co. The proposed route is eighty miles long. The irrigation canals in San Diego Co., San Luis Rey, San Jacinto and Pamo, will require $1,000,000 to complete them.

Pasadena, Cal.—An irrigation district is to be formed under the State laws by the several water companies now operating plants in this place, and a committee has been appointed to bring the matter before the citizens. The committee consists of one representative from each of the companies and three citizens.

SEWERAGE AND MUNICIPAL.

Sewers have been ordered at Middletown, Conn.; Troy N. Y., brick 27 × 40 in.; Buffalo, N. Y., estimated cost $61 200; Wheeling, W. Va.; Toronto, Ont.; Columbus, O.; Duluth, Minn., estimated cost, $11,783; St. Paul, Minn.

Toronto, Ont.—City Engineer Jenkins has submitted his plans for the new sewerage system. They call for a high level sewer draining a district of 8,709 acres, with a population of 300,000, a low level sewer for a district of 1,430 acres, with a population of 55,500, and several small branches. The main sewers will discharge into Lake Ontario and, together with the branches, will cost about $1,633,000.

Batavia, N. J.—A chemical precipitation plant costing $12,500 will be built at the Institution for the Blind.

Jacksonville, Fla.—Ordinances for 4 miles of sewers have been introduced.

Vicksburg, Tenn.—Engineer Haynes has reported in favor of the Waring system of sewers. The main sewer will be 3 miles long and 2 ft. in diameter, with about 14 miles of laterals.

Cicero, Ill.—Town Engineer Alvord has prepared plans for sewering the 17¾ sq. miles of the town. Sewers are

on the combined system, and automatic flushing tank are recommended for the old pipe sewers whose grades are too flat to be self cleaning.

Duluth, Minn.—Assessment rolls for a sewer costing $43,070 have been prepared.

Denver, Colo.—The Board of Public Works has passed an order for a new sanitary sewer to cost $82,240.

Paving has been ordered at Concord, N. H., where $5,000 have been appropriated; Providence, R. I.; Greenbush, N. Y.; Wheeling, W. Va.; Louisville, Ky.; Bridgeport, O., brick; West Duluth, Minn., where $25,000 have been appropriated for street improvements; St. Paul, Minn., where a large amount of grading has also been ordered.

Albany, N. Y.—The City Engineer has prepared plans for 15,140 sq. yds. of Trinidad asphalt pavement.

Greenbush, N. Y.—The trustees have ordered considerable Belgian block paving, all property holders to have the right to let the work in front of their own premises to responsible bidders.

Rochester, N. Y.—Extensions costing $12,000, Medina stone paving, costing $19,700, and $8,500 of asphalt block paving have been recommended. Vulcanite asphalt at an estimated cost of $28,000 has been ordered.

Atlanta, Ga.—Vitrified brick is to be tried in this city, the brick being furnished by the Chattahooche Brick Co.

Jacksonville, Fla.—Ordinances for $50,000 of paving have been introduced.

Cincinnati, O.—The City Engineer has prepared plans for street improvements, the estimated cost of which is $93,230.

Columbus, O.—Paving with asphalt, granite or brick has been ordered on several streets; also considerable grading.

St. Louis, Mo.—Telford paving has been ordered on several streets.

Duluth, Minn.—Assessments for $46,000 of grading and $27,800 of paving have been levied.

Portland, Ore.—A system of boulevards similar to those at Chicago will probably be built. Right of way for over 50 miles of 100-ft road is said to have been obtained.

Bonds.—*Water Valley, Miss.*—An election will be held Sept. 29 on a proposition to issue $10,000 of electric light and water-works bonds.

Wilton, Ia., has decided to issue $14,000 of special bonds for water-works and an electric light plant.

ELECTRICAL.

Electric Light.—Plants are proposed at Milford, N. H.; Florence, S. C.; Earlington, Ky.; Beeville and Winchester, Tex.; Morrillton, Ark.; Fairhaven, Wash.

Newark, N. J.—The Electric Light and Power Co. owning the Newark plants of the Schuyler Electric Light Co. and the Thomson-Houston Co., has let contracts for its new central station, which will have a capacity of 200,000 incandescent lamps, or their equivalent in arc lights or motors.

Hopkinsville, Ky.—The city will erect an electric light plant and construct water-works after Jan. 1, 1891.

Temple, Tex.—The Electric Light Co. has ordered a 1,000 incandescent lamp plant of the Heisler Electric Light Co.

Anderson, Cal.—The Anderson Water Power Co. will probably install a 200-lamp plant.

New Companies.—Kennedy-Griffith Electric Co., Camden, N. J.; capital, $1,000,000; object, manufacture of electrical machinery. Orient Electric Co., Portland, Me.; capital, $100,000; object, manufacture of electrical supplies. Cohasset, Mass., Electric Co.; A. Lawrence, Pres't. Palmyra, N. J., Light & Power Co.; capital, $50,000; incorporators, B. F. Hobart, E. B. Loveland, W. P. Heath and others. Dawn Electric Co., Chicago, Ill.; capital, $10,000; incorporators, J. A. McEntee, H. P. Williams and J. M. Glann. Waynesboro, Ga., Electric Light Co.; capital stock, $7,500; W. A. Wilkins, Pres't. The Valley Electric Light & Power Co., Wellsville, O.; capital, $25,000. Quanah, Tex., Water, Ice & Electric Light Co.; capital, $75,000. Ball Light & Power Co., Montgomery, Ala.; E. W. Thompson, Sec'y.

Subway Construction.—*New York City.*—During the current year, 158,180 ft. of trench have been dug and 774,930 ft. of ducts laid, against 56,040 ft. of trench and 621,430 ft. of ducts in the whole of 1889.

CONTRACTING.

Sewers.—*Omaha, Neb.*—The bids for the 7-ft. brick sewer in North Omaha, were as follows: F. L. Reeves, $10.89 per lin. ft.; C. E. Fanning & Co., $10.45; J. E. Riley & Co., $10.85; P. C. McHugh, $10.78.

Denver, Colo.—J. E. Riley & Co. have received contracts for constructing brick sewers amounting to $48,000

Milwaukee, Wis.—Section 10 of the special sewarage works has been awarded to James Markey at $7.25 per ft. for 54-in. sewers, $3.25 for 24-in., and $150 for each double manhole.

Bituminus Sidewalks.—*Oakland, Cal.*—Recent bids ranged from 10 to 10.9 cts. per sq. ft.

Granite Block Repaving.—*Brooklyn, N. Y.*—Recent bids ranged from $2.28 to $2.36 per sq. yd of repaving.

Brick—*Washington, D. C.*—Recent bids for 400,000 vitrified paving brick were at $19 and $20.80 per M.

Street Lighting.—*Jamaica, N. Y.*—Bids were recently opened for lighting the village for 3 years from Nov. 1. The Woodhaven Gas Light Co. offers to light the village all night, every night, $15.20 per lamp; on the lunar system, that is, lamps extinguished at midnight and not lit on moonlight nights, $8 per lamp, the lights to be not less than 22 c. p. The Jamaica Gas Light Co. put in its bid on the all-night system for $20 per lamp per year; on the lunar system $12 per year; 16 c. p. George B. Ellery, of 137 Broadway, New York, offers to put in electric lights at these rates: 18 c. p. $1.20 per month per lamp, on the lunar system; 20 c. p., $1.50; 32, $2.20; 45, $2.70; 60, $4.20; 100, $5.50. For all night double these rates; for the full 24 hours 4 times the price.

Cut Granite—*Des Moines, Ia.*—The contract for furnishing 1,000 tons of cut granite for the State Capitol improvements has been given to G. Green & Co., S. Thomaston, Me., at $2.13 per cu. ft. delivered on cars at Des Moines.

PROPOSALS OPEN.

Streets.—*Brooklyn, N. Y.*—Grading and cobble stone paving. J. J. Adams. Sept. 12.

New York City.—Grading and paving with granite blocks or asphalt. T. F. Gilroy, Sept. 8.

Rochester, N. Y.—Grading and paving with asphalt on several streets. T. J. Neville, Sept. 10.

Columbus, O.—Grading and paving with asphalt, stone or vitrified clay blocks, or vitrified brick on several streets. F. M. Senter, Sept. 12.

Madison, Wis.—Grading and macadamizing. O. S. Norman, Sept. 10.

St. Paul, Minn.—Grading. R. L. Gorman, Sept. 11.

Pump.—*Baltimore, Md.*—A second-hand Knowles tank pump, 7½-in. cylinder, 10-in. stroke. Address T., 417 Baltimore *Sun*.

Sewers.—*Troy, N. Y.*—E. O. Ross, Sept. 9.

Rochester, N. Y.—Pipe sewers. T. J. Neville, Sept, 10.

Buffalo, N. Y.—A number of brick, stone and pipe sewers. G. E. Mann, Sept. 10.

New York City.—T. F. Gilroy, Sept. 8.

Cleveland, O.—C. G. Force, Sept. 11.

Levee Work.—*Tullulah, La.*—Five levees of approximately 350,000, 30,500, 40,000, 20,000, 80,000, and 50,000 cu. yds. Levee Board, Sept. 20.

Bridges.—*Dublin, Ga.*—Iron bridges across the Oconee River at Dublin; 320 ft. long, 18 ft. wide, with a draw of 80 ft. clear space on each side of the pivot pier. J. TDuncan, Oct. 20.

Faribault, Minn.—One bridge of two 65-ft. spans and a single span bridge of 36 ft.; width of roadway, 16 ft. L. Hawley, Sept. 15.

Bucoda, Wash.—Highway bridge of 75 ft. span, and 18 ft. width. J. Gibson, Sept. 17.

Wharf.—*Boston, Mass.*—About 400 ft. long, 12,500 sq. ft. area and requiring 445 oak piles. Metropolitan Sewerage Commission, Sept. 10.

Removing Wrecks.—*Newport, R. I.*—Maj. W. R. Livermore, Sept. 26.

Wilmington, Del.—W. F. Smith, Sept. 29.

Electric Light Plants.—*U. S. S. Lancaster.*—G. E. Dewey, Navy Dep't., Bureau of Equipment, Washington, D. C., Sept. 10.

Machine Tools.—*Brooklyn Navy Yard.*—Shearing machines, planers, drills, lathes, testing machines, etc. Paymaster-General E. Stewart, U. S. N., Washington, D. C., Sept. 16.

Breakwater.—*Bar Harbor, Me.*—Furnishing and placing stone on breakwater. Lieut.-Col. J. A. Smith, U. S. A., Portland, Me., Sept. 25.

Steam Launch—*Washington, D. C.*—About 16 tons displacement. W. M. Folger, Bureau of Ordnance, U. S. N., Washington, D. C., Sept. 10.

Lock No. 1, Cumberland River.—*Nashville, Tenn.*—Lieut.-Col. J. W. Barlow, U. S. A., Sept. 23.

Yellow Pine Lumber.—*Washington Navy Yard.*—Paymaster-Gen. E. Stewart, U. S. N., Sept. 16.

Boilers.—*Washington, D. C.*—Six horizontal tubular boilers for Gov't. Hospital, Dep't. of Interior, Sept. 24.

Water-Works Supplies.—*Brookline, Mass.*—About 800 ft., of 6-in cast iron water pipe, also proposals in a separate bid for laying same. Water Board Sept. 10.

West Knoxville, Tenn.—Twenty-five hydrants. Knoxville Water Co.

Buildings.—*Jamestown, N. Y.*—State Armory. I. G. Perry, Albany, N. Y., Sept. 10.

Taylorville, Ill.—School house. J. C. McBride.

Kansas City, Mo.—County Jail. A. Van Brunt, Sept. 15.

Albuquerque, N. M.—University building. J. M. Wheelock, Sept. 15.

Dredging.—*New York City.*—34,700 cu. yds. Dock Dep't. Sept. 12.

MANUFACTURING AND TECHNICAL.

Cars.—The Ohio & Mississippi Ry. recently ordered 250 box cars of the Ohio Falls Car Works. The Indianapolis Car Works have been awarded a contract for 125 cars by the Atlanta & Florida R. R.

The Brooks Locomotive Works recently sent two engines to the Mexican National R. R.

The Pennsylvania Steel Co. has completed its plant at Sparrow Point, on Chesapeake Bay, which cost $2,500,000. The business rating of the company can be understood from the fact that no stock could be bought recently in Philadelphia at $200, an advance of 100% over its par value.

An Aveling & Porter Road Roller has been ordered by the city authorities of Madison, Wis.

The Asphaltic Slag Paving and Roofing Co. is running its works to full capacity in the manufacture of roofing alone. The officers of the company now are: Pres., Gen. Fitz John Porter; Vice-Pres., W. Bouldin, Jr.; Sec'y, R. S. Masterson; Treas., N. S. Easton; General Manager, G. S. Lee.

The Knowles Steam Pump Works, at Warren, Mass., recently shipped two large oil pumps to the Standard Oil Co.'s yards at Cleveland, O.

W. R. Coats & Co., Owosso, Mich., are now engaged in constructing the water-works at Owosso and Iron Mountain, Mich., the latter a $125,000 contract, and have the Owosso sewerage system under consideration.

Dam.—The canal and dam at Austin, Tex., will require 17,000 cu. yds. dimension stone masonry, 70,000 cu. yds. rubble stone masonry, 75,000 cu. yds. earth excavation and 55,000 cu. yds. rock excavation.

The Indiana Natural Gas & Oil Co., has filed articles of incorporation at Marion, Ind. The capital stock is $5,000,000, and the directors are P. A. McElwan, J. B. Cohns, A. Hayes, F. S. Finston and R. C. Beld. The object of the company is to pipe natural gas from the Indiana fields to Chicago.

New Companies.—Durham Consolidated Land and Improvement Co., Durham, N. C.; capital, $1,000,000; incorporators, J. Carr, A. B. Andrews, R. H. Wright, J. Yancey, Jr.—Hanrahan Automatic Refrigerator Car Co., Chicago, Ill.; capital, $500,000; incorporators, W. A. Laidlaw, C. B. Moore, L. C. Brooks.—Youngstown, O., Steel Co.; incorporators, H. Wick, T. H. Wells, J. C. Wick, W. H. Baldwin, G. D. Wick; capital, $1,000,000.—Equity Gas Works Construction Co., New York City and Jersey City.—Durbrow Well Co., San Francisco, Cal.; capital, $200,000; incorporators, G. W. Durbrow, J. Bermingham, O. E. Brady, H. Durbrow, W. M. Pierson.—Huntington, Ind., Fuel and Light Co.; capital stock, $25,000; incorporators, J. K. Brice, F. D. Townsend, J. J. Bippus, H. F. Willis, O. W. Whitlock.—Johnson Fuel Gas and Construction Co., Topeka, Kan.; capital, $200,000; incorporators, C. P. Baker, T. D. Cook, J. R. Moore, F. B. Johnson, F. M. Comstock and others.—Pacific Wenstrom Electric Railway Co., San Francisco, Cal.; capital, $20,000; incorporators, D. E. Ryland, H. T. Scott, J. T. Scott, D. I. Mahoney.—Anglo-American Parlor Car Co., Porter County, Ind.; capital, $15,000,000.

The Ashland, Ky., Steel Co. has been formed by the consolidation of the Belfont Iron Works and Kelley Nail and Iron Works, of Ironton, O., and the Norton Iron Works, of Ashland. A new steel plant of 300 tons daily capacity will, it is said, be immediately built.

The Abendroth & Root Manufacturing Co., has recently received an order for another 1,000 HP. boiler for the Edison Electric Light Co., of Philadelphia, Pa., said to be the largest electric light station in the country.

An electric crane has been in successful use for some 9 months in the erecting shop of Wm. Sellers & Co. An Edison compound-wound dynamo of 50,000 watts capacity sends a current through a double wire and a Wheeler trolley to a 15 HP. Sprague motor, which furnishes the motive power of the crane. The capacity is 50 tons, with a 200 ft. runway.

Metal Market Prices.—*Rails*—New York: $31; for old iron rails, $24.50 to $25. Chicago: $33.50; old rails, $26.50 for iron, $18.22 for steel. Pittsburg: $31.50 to $32.50; old rails, $27.50 to $28 for iron; $21.50 to $22.50 for steel.

Foundry Pig-iron.—Chicago: $15.50 to $17.50. Pittsburg: $15.75 to $17.50. New York: $16 to $18.

Track Materials.—New York: steel angle bars, $1.90 to $1.95; spikes, $2.05 to $2.15; track bolts, 2.95 to 3.10 cts. with square, and 3.10 to 3.15 cts. with hexagon nuts. Pittsburg: splice bars, 1.95 to 2 cts. for iron, 2 to 2.1 cts. for steel; spikes, 2.15 cts.; track bolts, 2.85 with square, and 3 cts. with hexagon nuts. Chicago: splice bars, 2.25 cts. for steel, and 2 to 2.1 cts. for iron; spikes, 2.25 cts; track bolts 3.05 to 3.15 cts. with hexagon nuts.

Pipe.—Cast-iron, $27 to $30 per ton. Wrought iron, discounts as follows: 47½ and 40 per cent. on black and galvanized butt-welded; 60 and 47½ on black and galvanized lap-welded. Casing, 50 per cent.

Lead.—New York, 4.55 to 4.65 cts.; Chicago, 4.47½ to 4.6 cts.

Structural Material.—Pittsburg: angles, 2.2 to 2.25 cts.; tees, 2.8 to 2.85 cts.; beams and channels, 3.1 cts.; sheared steel bridge plates, 2.7 cts.; universal mill plates, 2.55 cts.; refined bars, 1.9 to 2 cts.; steel plates, 4.25 to 4.75 cts. for fire box; 3.2 to 3.25 cts. for flange; 3.05 cts. for shell, 2.7 to 2.75 cts. for tank. New York: beams, 3.10 cts.; plates, 2.15 to 2.20 cts.; angles, 2.25 cts.; tees, 2.5 to 2.6 cts.; channels, 3.1 cts. Chicago: angle, 2.35 to 2.4 cts.; tees, 2.8 to 2.9 cts.; beams, 3.2 cts.; universal plates, 2.45 to 2.55 cts.

New Water-Works, Atlanta, Ga.

Sealed proposals will be received at the Mayor's office in the city of Atlanta, Ga., until 12 o'clock meridian, on the 1st day of October, 1890, for furnishing material and constructing new water-works, approximately as follows:

One horizontal pumping engine, boilers, etc., with capacity of pumping 10 million gallons in 24 hours against a head of 235 feet.

One horizontal pumping engine, boilers, etc., with capacity of pumping 6 million gallons in 24 hours, against a head of 350 feet.

One filter plant of a capacity of filtering by gravity under a head of 20 feet, 3 million gallons in 24 hours.

Two engine houses and 2 smoke stacks.

One reservoir—60,000 cubic yards of earth excavation, 1,000 yards rock excavation, 10,000 brick laid, 50 cubic yards concrete.

One clear water basin—3,500 cubic yards earth excavation, 500 cubic yards of rock excavation, 450,000 brick laid, 400 square feet concrete.

Pumping well and intake—3,000 cubic yards of earth excavation, 1,000 cubic yards rock excavation, 200,000 brick laid and 100 cubic yards concrete.

Cast iron pipe and specials—
600 lineal feet of 36-inch pipe.
28,000 lineal feet of 30-inch pipe.
7,500 lineal feet of 20-inch pipe
Valves, tees, crosses, valve boxes, etc.

Two pumping stations, consisting of 2 engine and 2 boiler rooms, one pumping well, one clear water basin and two brick chimneys.

Pipe laying—600 feet of 36-inch pipe, 28,000 feet of 30-inch pipe, 7,500 feet of 20-inch pipe, including valves, valve boxes and specials.

The above quantities and dimensions are to be considered approximate only, the committee reserving the right to increase or diminish as they may elect after receiving bids. Bids will be received for the whole or any particular branch or sub-division of the work.

Specifications and general plans can be seen at the office of the City Engineer or Superintendent of Water-works, Atlanta, Ga.

A certified check for $1,000 must accompany each bid, payable to John T. Glenn, Mayor, to be forfeited in the event of award and a failure to contract within 10 days. The right is reserved to reject any or all bids.

JNO. T. GLENN, Mayor.
R. M. CLAYTON, City Engr.
WM. G. RICHARDS, Supt. W. Wks.
36-4t

Toledo, Iowa, Water-Works.

Sealed proposals will be received by the city of Toledo, Iowa, until 2 o'clock P. M., Sept. 23, 1890, for the construction of a system of water-works according to plans and specifications on file in the Recorder's office at Toledo, and also in the office of Geo. Cadogan Morgan, 15 Major Block, Chicago.

All proposals must be sealed and marked "Proposals for Water-works" and filed with the Recorder of said city by the time above indicated, and be accompanied with a clearing-house check payable to the treasurer of said city for the sum of $250, as a guarantee of good faith; the same to be returned when proposal is rejected or accepted and a satisfactory bond deposited with the common council.

The city reserves the right to make any additions to or deductions from the accepted proposal to the amount of fifteen (15) per cent. of the same at any time before the goods are ordered, or work done on all or any part of the system, and the right is still further reserved to reject any and all bids.

A. G. SMITH, Recorder. A. M. BEAL, Mayor,
36-1t. Toledo, Iowa.

WRECK OF SCHOONER WEYBOSSET.—Engineer Office, U. S. Army, Newport, R. I., Aug. 27, 1890.—To whom it may concern.—Whereas, navigation is obstructed and endangered by the wreck of the schooner Weybosset, lying about 700 feet S. S. W. of the Bell Buoy north of Pollock Rip Light Ship; Notice is hereby given to all persons interested in said vessel, her cargo and all other property therein, that if, within thirty (30) days from the date of this advertisement, they shall have not signified to me their intention, and taken preliminary steps to remove said wreck, etc., as soon as practicable, the same will be considered as abandoned and derelict, and it will be removed by the United States under authority of law. Sealed proposals, in triplicate, for the removal of said wreck, will be received at this office until 12 o'clock, noon, on Friday, the 26th day of September, 1890, and then opened. The attention of bidders is invited to the Acts of Congress approved Feb. 26, 1885, and Feb. 23, 1887, Vol. 23, page 332, and Vol. 24, page 414, Statutes at Large. The United States reserves the right to reject any or all proposals, and to waive any informalities. Full information furnished on application. By authority of the Secretary of War. W. H. LIVERMORE, Major of Engineers. 36-3t.

S. E. NOBLE, Prest. JNO. E. WARE, Secy. and Treas. R. F. CARTER, Supt.

The Anniston Pipe Works,

MANUFACTURERS OF

CAST IRON WATER AND GAS PIPE,

ANNISTON, - - - - ALA.

Especially adapted for the Elevation of Clear, Gritty, Thick, or Acidulous Liquids, Quickly, Cheaply and Efficiently

THE NEW PULSOMETER STEAM PUMP.

without Engine, Machinery, Oil, Expensive Power, Skilled Labor, or Material Wear. Send for Illustrated Catalogue.

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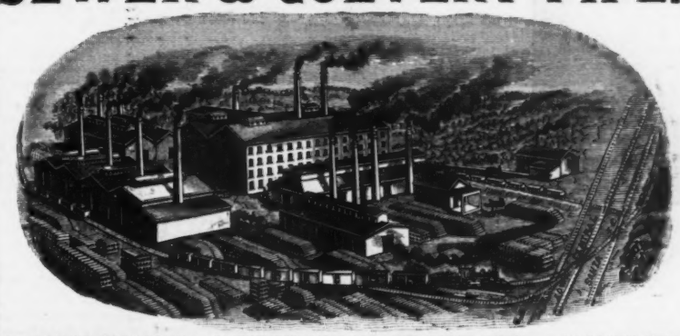
DOUBLE STRENGTH

SEWER & CULVERT PIPE.



MONMOUTH MINING & MFG. CO., MONMOUTH, ILL.

To Manufacturers of Pumping Machinery.

Sealed proposals will be received at the office of the City Secretary of the City of Dallas, Tex., until 6 o'clock P. M., Wednesday, Sept. 24, 1890, for constructing and placing in position in the pumping station at Turtle Creek in said city one 10,000,000-gall. vertical compound condensing pumping engine. Proposals will also be received at the same time for furnishing and setting up at the same pumping station two (2) 60-in. by 16-ft. return tubular steel boilers and five (5) new boiler fronts.

All to be in accordance with general plans and specifications on file with the City Secretary. Certified checks to accompany bids as follows: With bid on pump, check for $2,500, and with bid on boilers a check for $500. The city reserves the right to reject any or all bids.

36-2t W. McGRAIN, City Secretary.

Artesian Well.

Sealed proposals will be received by the undersigned at the City Hall, Galveston, Texas, up to 12 o'clock, noon, of Thursday, Sept. 25, A. D., 1890, for the boring of an artesian well in the City of Galveston, to a depth of 3,000 ft., unless satisfactory water is procured at a lesser depth. Bidders to give price per foot for finishing with 6-in., 8-in., 10-in. and 12-in. pipe respectively. The right to reject any or all bids is reserved. THOS. W. JACKSON,

35-5t Chairman of Special Committee.

To Sewer Contractors.

Proposals will be received until Monday, Sept. 8, 5 P. M., by James J. Bergen, President of Board of Commissioners of Somerville, N. J., for constructing approximately four miles of sewers at Somerville, N. J., as follows: 800 ft. 24-in., 1,300 ft. 20-in., 3,730 ft. 15-in., 920 ft. 12-in., 720 ft. 10-in., 1,380 ft. 9-in., 11,240 ft. 8-in., with manholes, basins, inlets and appurtenances.

A certified check for $500, drawn to the order of L. R. Vredenburgh, Treasurer, must accompany each bid as an evidence of good faith.

The right is reserved to reject any and all bids. Plans may be seen at the office of Jas. Dougherty, Somerville, N. J., or at the office of the engineer in charge, Carrol Ph. Bassett, 784 Broad St., Newark, N. J.

(Signed) JAS. J. BERGEN,
Pres. Board of Commissioners of
35-2t Somerville, N. J.

Coldwater, Mich., Water-Works.

Notice to Contractors.

SEALED PROPOSALS will be received by the Water-Works Committee of the City of Coldwater, Mich., at their office in said city until 10 o'clock A. M. of Tuesday, the 16th day of September, 1890, for furnishing all materials and constructing water-works in and for said city.

The pipe distribution will consist approximately as follows: 240 lin. ft., 16 tons 16-in.; 1,250 lin. ft., 52 tons 12-in.; 5,800 lin. ft., 188 tons 10-in.; 18,660 lin. ft., 467 tons 8-in.; 29,180 lin. ft., 481 tons 6-in., and 12,730 lin. ft., 146 tons of 4-in. pipe; total, 1,350 tons of pipe and 30 tons of special castings. Also, thirty-one 4-in. valves, thirty-eight 6-in., fourteen 8-in., two 10-in., and one 12-in. valve.

Also, 86 valve boxes and covers; also, 100 fire hydrants.

The pumping station will consist of one brick building, sub-divided into an engine room, a boiler room, a coal room and working room; the engine and boiler rooms to be large enough to accommodate an electric light plant, all as per detail drawings.

The supply well will be approximately 30 ft diameter and 30 ft. deep, walled with brick and covered with ornamental well house. Bids will also be received for six or more 6-in. pipe wells, as per general specifications; also, for such a system of wells as bidders may elect to submit specifications and proposals for.

The pumping machinery, as now contemplated, will consist of two compound duplex condensing pumping engines, each with safe and easy capacity to pump one million five hundred thousand (1,500,000) gallons of water per 24 hours; arranged to work most economically under ordinary current pressure of 50 to 60 lbs., with additional strength of parts sufficient to work safely against fire pressure of 150 lbs. per sq. in. Bids will also be received for such cheaper type of engines as may be described in specifications.

The boilers will consist of two return tubular steel boilers, each approximately 60 ins. diam. and 16 ft. long. Bids will also be received for such other type of boilers as bidders may elect to submit, or as may be described in general specifications.

Bids for pumping machinery will be understood to include foundations and settings complete, and bids for boilers will be understood to include all foundations, settings and fixtures complete, unless otherwise expresely stipulated.

Specifications, forms of proposal and forms of contract will be furnished from and after Sept. 6, and the necessary detailed drawings will be ready for the examination of bidders from and after Sept. 10, 1890.

Bids will be received for the entire work in the aggregate, or in detail, at the option of bidders. The right to reject any or all bids is hereby reserved.

E. R. CLARKE, Mayor.
E. J. ALLEN, Clerk.
F. E. MORGAN, Secretary of Water Committee.

J. D. COOK, Toledo, O., Consulting Engineer.
COLDWATER, Mich., Aug. 26, 1890.

35-2t

Notice to Contractors for Water Works Plant.

OFFICE OF THE COMPTROLLER,
CITY OF ALLEGHENY, Aug. 7, 1890.

Sealed proposals will be received at this office until 12 o'clock noon Wednesday, October 1, 1890, for doing the following work viz.:

PUMPING ENGINES.

For the construction and erection of two pumping engines of a capacity of 8,000,000 gallons each, to be of the type known as the vertical direct-acting three-cylinder compound condensing engines, with a combined capacity of pumping 16,000,000 gallons every 24 hours against a head of 300 feet, with a piston speed not exceeding 120 feet per minute.

RESERVOIRS.

For the construction of two basins having 460 by 600 feet surface at foot of embankments, said embankments to be 30 feet above bottom of basins. The reservoirs to have one inlet and one outlet gate chamber.

STOP GATES.

For furnishing six sixty-inch stop gates, to be doubled seated, with parallel-faced valves of easy adjustment, to be operated with two screw stems parallel to each other, and connected by suitable gear.

BOILERS.

For a 1,500 horse-power boiler plant; boilers to be set up in batteries not exceeding 300 horse power, with a given guarantee on evaporative power of boiler per pound of coal consumed. Boilers will be placed in position and set up by the contractor on foundations furnished by the city.

FILTERING PLANT.

Proposals will be received for the construction and erection of a filtering plant to be used in connection with new water service, to be erected at a point nine miles up the Allegheny River. Bidders to furnish their own plans and specifications, erect their plants, and operate the same for a period of not less than six months on trial, and if satisfactory to the Committee on Water and Superintendent of Water-Works, the contract price to be paid; if not satisfactory, they to remove the plant without cost to the city.

CONDUIT AND FORCE MAINS.

For the construction and laying of a 60-inch steel or iron conduit from Nine-Mile island to the city, about 8.74 miles, to be in sections of 24 ft. in length from center to center of joints. Manholes to be provided for every 40 sections of water main. Elbows for vertical and horizontal inclinations to be provided for, with angles as shown on plan and profile. Force main to be fifty (50) inches in diameter, and constructed as per plans and specifications.

Plans and specifications for buildings, reservoirs, conduit force mains and delivery pipe will be furnished by the city.

Bidders will furnish their own plans and specifications in full detail for engines and boilers, and their connections, with necessary plans for foundations for same.

Proposals will be received for the construction of the whole work, or separately, as bidders may elect.

Plans and specifications may be seen and all information in regard to the above work can be obtained at the office of the Superintendent of Water-Works, and all correspondence in relation to the same should be addressed to Edward Armstrong, Superintendent, City Hall, Allegheny, Pa.

A bond must accompany each proposal to the full amount of the bid, with sufficient sureties for the faithful performance of the contract.

The right is reserved by the Committee on Water to accept or reject bids for the whole or any part of the above work.

JAMES BROWN,
33-6t Comptroller.

Rushville, Ind., Water-Works.

Proposals will be received by the Common Council of the city of Rushville, Ind., until 12 o'clock M. Tuesday, Sept. 16, 1890, for the construction of a system of water-works, under a franchise to be granted by said city.

The city reserves the right to reject any and all bids.

The successful bidder will be required to enter into bond within 10 days conditioned for the compliance with the terms of his bid.

WILSON T. JACKSON,
36-1t Mayor.

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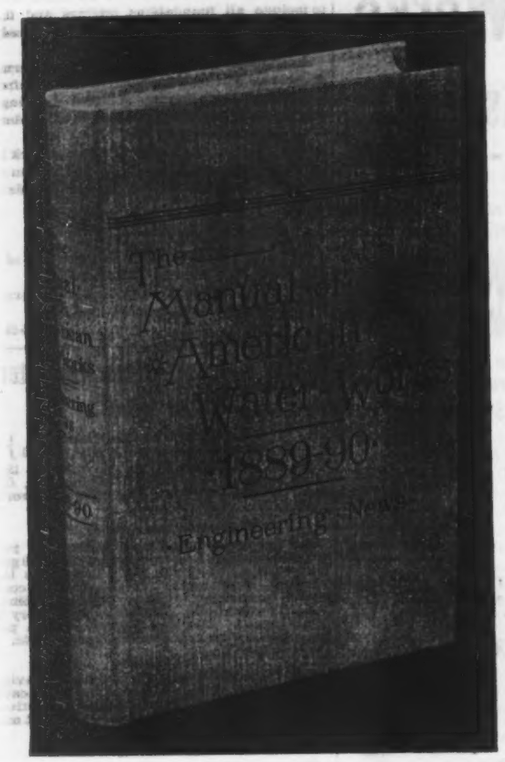

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BALTIMORE, Aug. 27, 1890.

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NOTICE TO CONTRACTORS.

The city of Austin, Tex., will receive bids until 12 o'clock noon of Oct. 15, 1890, for construction of a DAM across the Colorado River and excavation of a HYDRAULIC CANAL near Austin.

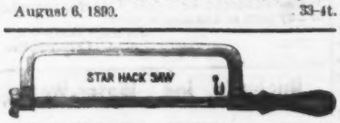
Said work involves some

17,000	cu. yds.,	dimension stone masonry;
70,000	"	rubble " "
75,000	"	earth excavation;
55,000	"	rock "

Full information, with specifications and forms for proposals, contract and bonds, may be obtained on application to John McDonald, Mayor, or Jos. P. Frizell, Engineer, Austin, Tex.

JOHN McDONALD, Mayor.

August 6, 1890. 33-4t.



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Sealed Proposals.

CLERK'S OFFICE,
TOWNSHIP OF EAST ORANGE, N. J.

Sealed proposals for furnishing about three hundred granite street monuments will be received by the Township Committee of the Township of East Orange, N. J., on or before Sept. 8, 1890, at eight o'clock P. M. Plans and specifications may be procured of Wm. H. V. Reimer, Township Engineer, 249 Main street, Orange, N. J. The committee reserves the right to accept or reject any or all bids.

Proposals must be directed to Alfred F. Munn, Township Clerk.

ALFRED F. MUNN,
35-2t Township Clerk.

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WANTED.—Thomas M. Jacks, City Engineer of Helena, Ark., wants an engineer of experience to assist in the resurvey of the streets, squares, etc., of the city of Helena, Ark., embracing about 800 acres of land inhabited by 8,000 people. Applicants please address THOMAS M. JACKS, City Engineer, Box 17, Helena, Ark. 33-4t.

WANTED—A trackmaster of experience. A liberal salary will be paid. Apply by letter, giving references, to TRACKMASTER, care of Engineering News. 34-4t

WANTED.—A sober, good-tempered, experienced engineer to take charge of erection and operation of rock drills, air compressors, Corliss engines and general machinery in a mine in a foreign country; must be experienced with Ingersoll-Sergeant machinery; contract for one year, with privilege of renewal; pay $5 per day and expenses, including board and lodging; only experienced men, highly recommended, will be considered. Address WILLIAM L. SAUNDERS, 10 Park Place, New York. 34-4t

WANTED.—Ten (10) experienced rock foremen to work on extension Norfolk & Western Railway, in Wayne County, W. Va. Good wages to experienced foremen. Apply at Louisa, Ky., on the Ohio & Big Sandy Railway, eight miles from work. GEO. S. GOOD, Contractor. 35-2t

WANTED.—The services of two divers with all apparatus for about two months from Sept. 15. H. S. JACKSON & CO., Cole Building, Nashville, Tenn. 36-1t

WANTED.—Two competent bridge draughtsmen familiar with making shop drawings. State experience, salary required and how soon services available. Address BINDER & SEIFERT, 803 Royal Insurance Building, Chicago. 36-1t

WANTED.—A well recommended young man of good character, ability and temper, and a neat draughtsman and penman, having had some field or office experience and one or more years study in engineering school can have an opportunity of paying his board and also his tuition, in a leading southern engineering school having extensive facilities for instruction, by giving a moderate amount of general assistance in a private engineering office. Some shorthand ability preferred. Address O. H. I., care Engineering News. 36-2t

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WANTED.—Capitalists to invest in the manufacture, and to form companies to manufacture and to procure franchises to build water-works on the best water pipe and patented joint now in operation. To those wishing to become interested a strict examination of the pipe and joint is solicited. For particulars enquire of CHAS. T. LEONARD, Norwalk, Conn. 32-5t

WANTED.—A partner in a contract that promises good returns. A man who can command $50,000 can find good security and good profits. He should be a capable accountant and able to attend to the office work. Address VAN AUKEN, Engineering News. 34-3t

WANTED.—Dredge machinery, new or second-hand; dipper dredge, one or one and one-half yard dipper and engines of suitable size. Address C. I. McDONALD, Lock 8, Putnam Co., W. Va. 36-2t

IMPROVEMENT OF PHILADELPHIA HARBOR, U. S. Engineer Office, 1423 Arch street, Philadelphia, Pa., Aug. 16, 1890. Sealed proposals, in duplicate, will be received at this office until 11 A. M. Tuesday, Sept. 16, 1890, and then opened, for dredging in Philadelphia Harbor, Pa., for removal of Smith's and Windmill Islands. The attention of bidders is invited to the Acts of Congress approved Feb. 26, 1885, and Feb. 23, 1887, Vol. 23, page 332, and Vol. 24, page 414, Statutes at large. For all information apply to C. W. RAYMOND, Major of Engineers, U. S. Army. 34-4t

PROPOSALS FOR LOCK CONSTRUCTION. Engineer's Office, U. S. Army, Nashville, Tennessee, August 18, 1890. Sealed proposals, in triplicate, will be received at this office until 3 P. M. Tuesday, September 23, 1890, for part construction and completion of Lock No. 1, Cumberland River, near Nashville, Tennessee. Bidders are invited to be present at opening of the bids. The United States reserves the right to reject any and all proposals. The attention of bidders is invited to the acts of Congress, approved February 26, 1885, and February 23, 1887, Vol. 23, page 332, and Vol. 24, page 414, Statutes at Large. Specifications and blank forms for proposals will be furnished on application at this office. J. W. BARLOW, Lieut Col. of Engineers. 35-4t

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WANTED.—A civil engineer with ten years experience principally on city work would like to secure an engagement lasting from four to six months beginning about October 1. Have been five years on New York City work; been assistant engineer of an Eastern city of 40,000; city engineer of another place for two years, besides having a large practice on other general work. Can make surveys, plans and take charge of construction of works of sewerage and anything under the head of city engineering, and am an expert on the most accurate city surveying. Am also an A1 map draughtsman and can send sample of work. Some railroad experience. Can furnish my own instruments. At present in Wisconsin. Address CITY ENGINEER, care of Engineering News. 33-4t

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WANTED.—Architect at present engaged in private practice wishes position with railroad company. Well up in designing, construction and business management. Has had experience in railroad work. Address ARCHITECT, care Engineering News. 35-2t

WANTED.—Situation after Nov. 15, 1890, as leveler or transitman on railroad or city work. Have had six years' experience in land and lot surveying, bridge and gravel road building, and public (country) drainage. Reason for change, expiration of term of office. Address COUNTY SURVEYOR, Box 66, Rushville, Ind. 35-2

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WANTED.—A young engineer, who can give good references, desires a place as transit observer or leveler with a corps on preliminary survey or location. Address "PERRY," care Engineering News. 35-4t

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